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Joint Eglin Acoustic Week III Data Report

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Abstract

A series of three flight tests have been conducted at an Eglin Air Force Base remote test range located in the Florida panhandle. The first was the "Acoustics Week" flight test conducted in September 2003. The second was the NASA Heavy Lift Rotorcraft Acoustic Flight Test conducted in October-November 2005. The most recent was the Eglin Acoustic Week III test conducted in August-September 2007. This series of tests acquired acoustic data for a number of rotary and fixed wing aircraft and are used to generate noise semi-spheres used in predicting the acoustic footprint for prescribed flight operations. This extensive database can be used to determine the impact of flight operations on communities around a terminal area as well as for prediction code validations. Another valuable use of the semi-spheres is determining the long-range propagation of noise for civilian and military purposes. This paper describes the third test in this series. Data described in this report were acquired during testing of the MD-902 and Mi-8M aircraft. In addition, data acquired during a set of atmospheric propagation tests is also described. All data discussed in this report is available on magnetic media upon request.

Introduction

Airport congestion and flight delays are increasing as passenger demand is growing. There was a significant downturn in passenger demand post-9/11, but demand has currently surpassed those pre-9/11 levels. Vertical lift aircraft can have a significant impact on reducing airport congestion and flight delays. The 1995 Civil Tiltrotor Development Advisory Committee Final Report to Congress [ref 1] found that "CTR (Civil Tilt Rotor) could produce significant societal benefits, reducing airport congestion, creating jobs, and having a positive impact on the balance of trade." A more recent study [ref 2] showed that 26% of commercial operations from the 64 major airports had a trip length of less than 500 miles and could be offloaded from conventional aircraft with Runway Independent Aircraft. This resulted in a reduction of the projected 2017 average delay time from 86.6 minutes to 18.3 minutes thus showing that V/ESTOL aircraft can have a significant impact on commercial operations. This study was not comprehensive in that it only addressed the 64 largest airports. It did not address delays caused by delays at other than these airports and thus the absolute magnitude of the delay difference is questionable. However, what it does indicate is that there can be a significant positive effect by replacing conventional with CTR operations.

Several barriers need to be overcome before the public will accept rotorcraft for commercial scheduled operations. One of the barriers is the acoustic impact of these operations on the community in and around the terminal area. The rotorcraft noise that is heard on the ground can be broken down into three research areas: source, propagation, and receiver, as shown in figure 1.

Noise from the rotorcraft is generated via several physical mechanisms depending on the flight condition. As this noise is propagated through the atmosphere, the acoustic signal is affected in various ways depending on the atmospheric conditions and the terrain. The person then perceives the signal in a way that is dependent on that individual's hearing acuity. NASA and other agencies are performing research into each of these three areas in an effort to develop flight procedures that will minimize the acoustic impact of noise on the community.

The Acoustic Week III, or Eglin III, acoustic flight test was performed at Eglin Air Force Base, Florida in August/September 2007 that acquired data specifically addressing all three of these areas. The data gathered are being used to validate predictive codes. This was a joint test with participation from NASA, Army- Aeroflightdynamics Directorate's Joint Research Program Office (AFDD-JRPO), DARPA, the USAF 46th Test Squadron's Chicken Little Joint Project Office and several contracted organizations such as the Army Research Laboratory's Survivability/Lethality Analysis Directorate (ARL-SLAD), the University of Mississippi's National Center for Physical Acoustics and Boeing. Data were acquired from three aircraft: MD Helicopters MD-902, Lockheed Martin VH-71 and Mil Mi-8M. The data acquired for the MD-902 and Mi-8M aircraft are publicly available. This paper will describe the testing of these aircraft, the propagation testing, and the data available. Because the VH-71 acoustic data are classified, no further discussion of the testing of that vehicle is provided in this paper.

Test Aircraft

NASA has previously acquired source noise for the MD series of aircraft including the MD-520N, MD-600N, and MD-900N. Thus it was decided to acquire more detailed data on the MD-902 to expand the already existing knowledge base. This aircraft is a 5 bladed, NO Tail Rotor (NOTAR®), light twin-engine utility helicopter. The aircraft is shown in figure 2 and the aircraft specifications are shown in Table 1.

NASA and the DoD are investigating the development of very large transport rotorcraft. The transport rotorcraft will have low fundamental frequencies that are beyond the current state-of-the-art predictive capabilities. However, understanding these low frequencies will be critical to enabling these type of rotorcraft to be used in military and civilian applications. Thus, a better understanding of the propagation and source noise prediction is needed for this type of aircraft. These reasons led to the selection of the Mi-8M for testing, as it was the largest helicopter with the lowest fundamental frequency available that fit the test schedule and budget constraints. The Mi-8M is shown in Figure 3 and the aircraft specifications are shown in Table 2.

Aircraft Instrumentation

The aircraft must not only be able to be flown on a reliable and repeatable flight track but its position as a function of time must be accurately measured. Aircraft parameters such as airspeed, heading, body angles and rates must be recorded for the most accurate interpretation of the data. A Differential GPS tracking and guidance system developed by Boeing-Mesa, under contract to NASA-LaRC, was installed on both aircraft to provide accurate real time pilot guidance and post processed vehicle position and state information. The self-contained instrumentation package installed in the passenger bay of the MD-902 is shown in figure 4. The flight test engineer input the flight parameters in the console shown in figure 5, which drove the pilot guidance indicator shown in figure 6. This system has been successfully used in past flight tests by NASA and is described in reference 3 All test aircraft had this instrumentation package installed during all data flights. This system allowed the actual flight track for the level flights to be maintained at +/-10 ft laterally and +/- 20 ft vertically to the desired or ideal flight track.

Source Noise

Source Noise Instrumentation

Source noise data were acquired for the purpose of creating noise semi-spheres that can be used in the Rotorcraft Noise Model (RNM) [ref 4] code to predict noise footprints on the ground for a prescribed flight profile. Source noise data were acquired using a similar technique and microphone setup as in the Eglin 2003 and Eglin 2005 flight tests [ref. 5]. The microphone setup for this test consisted of 19 microphones in a horseshoe-shaped array. The coordinate system used for Eglin III was with the origin at the center microphone, positive x along the flight path in the direction of flight, positive y to the left and positive z up. Two 175 ft cranes were located 800 ft apart. Four microphones were suspended from each crane as shown in figure 7. Eleven microphones were on ground boards between the cranes. Figure 8 shows the horseshoe array as seen from the aircraft. An additional microphone was placed on a 32.8 ft (10m) pole along the center of the flight path 50 ft before the array centerline microphone. All of these microphones were connected via coaxial cable to two data vans located 939 and 870 ft from the center of the microphone array. Data were low-pass filtered at 11,670 Hz, digitized at the microphone power supply box at 25,000 Hz, then transmitted via cables to the data vans where it was multiplexed with time and test run information and recorded.

A tethered weather balloon system was located 1.9 miles from the microphone array location. This balloon continually traversed from ground level up to 1000 ft altitude during the test runs. The data was recorded and post processed to give temperature, wind speed and direction and relative humidity measurements for all the test runs. Figure 9 shows the microphone on a ground board, weather balloon, acoustics data van and the analysis computers that were used for overnight data processing.

In addition to the wired microphones within the horseshoe, there were four Wireless Acoustic Measurement Systems (WAMS, figure 10) deployed outside of the array, aligned as closely as possible (as allowed by the terrain contour) with the projected angle of the aircraft over the center of the array through two crane microphone positions. The microphone locations are shown in figure 11 and detailed in table 3.

Source Noise Test Procedures and Conditions

Straight-line steady-state level flight, approach and departure flight conditions, as well as hover conditions, were flown during the Eglin III test. Test conditions were repeated as many times as were feasible for all flight conditions. Stable flight conditions were emphasized since even minor controls adjustments during a run can significantly change the noise generated by the vehicle. The aircraft approached the target location from a distance sufficient for the aircraft to obtain a stable state. The pilots were instructed to make as few control inputs as possible after this state was obtained and data acquisition was initiated. Data acquisition was initiated and terminated such as to yield the maximum usable data. For the level flight cases this distance was approximately +/-3000 ft and for the descent and departure cases this was approximately +/-5000 ft. These distances were chosen to be close enough to minimize the atmospheric effects yet also be far enough away to acquire data as close to the rotor tip-path-plane as possible.

Level flight source noise data were acquired with the aircraft flying at 150 feet above ground level (AGL) over the center microphone for airspeeds ranging from approximately 40 knots to the test aircraft's maximum level flight speed. Hover data were acquired by hovering at 150 feet above the ground and

performing a stepped rotation with data acquired at every 45 degrees. Approach data were acquired for descent angles ranging from 3 to 12 degrees. The aircraft would set up on the desired descent angle and airspeed in such a way so as to pass over the center microphone at an altitude of 250 feet AGL. Departure data were acquired by flying towards the array at 50 ft AGL at the specified airspeed and then initiating a 500 ft/min climb such that the aircraft passed over the center microphone at about 200 ft AGL. Table 4 shows the number of data points acquired for each level-flight, approach and hover condition for the MD-902 and Mi-8M. The number of departure points acquired for each aircraft is shown in table 5. Limited turning flight data was taken for the MD-902 by flying a circle centered over one of the cranes at 250 ft AGL. The turn was initiated upon entering the center of the array and stabilized with the aircraft allowed to drift with the wind to ensure minimal changing of the aircraft controls. Table 6 shows the matrix of circular flight points acquired. Figure 12 graphically shows these flight paths. Positive x is in along the flight path with y being to the left and z up. Ambient noise was acquired at least twice a day for each day of testing with each run lasting for one minute.

Tables 7 thru 15 detail the test points acquired during the source noise testing for the MD-902 and Mi-8M aircraft. Table 16 details the ambient data points taken during the entire Eglin III Acoustic Week test. These tables are in run number order and are a subset of the Microsoft Excel formatted run logs contained in the available electronic data. Table 17 contains the description and accuracy of all columns for the run logs for the Eglin III test. The target altitudes above the center microphone were; 150 foot for the level flight and hover; 250 foot for departure; 200 foot for approach; and 250 foot for maneuver. The aircraft parameters recorded by the flight engineer onboard the MD-902 included OAT, Q, and fuel remaining. The parameters recorded for the Mi-8M were Outside Air Temperature (OAT), Blade Angle of Attack (AOA), Engine Pressure Ration (EPR), Power Turbine Inlet Temperature (PTIT) and fuel remaining. These parameters are also listed in the test point tables.

Source Noise Data Processing

All source noise data from the MD-902 and Mi-8M have been processed and are electronically available upon request. Sound semi-spheres were created using the Rotorcraft Noise Model/Acoustic Re-propagation Technique (RNM/ART) methodology. The ART technique captures the noise spectra from all microphones at specific time intervals (typically every 0.5 seconds) along the flight profile and relates these spectra with the aircraft position, thus providing noise levels as a function of emission angle. These measured noise levels are then de-propagated to a semi-sphere of a specified radius centered at the aircraft. Atmospheric and speed effects are accounted for during this de-propagation process. This process is described more fully in reference 6. One-third octave band noise semi-spheres have been created with RNM/ART version 7 using the measured roll, pitch, heading, flight track, weather and acoustic data. All narrowband analysis used the average of five 4096-point Fast Fourier Transforms (FFTs) with a Hamming window and 50% overlap applied, resulting in 0.4915-second data blocks. These averaged narrowband spectra were computed every 0.5 seconds for each microphone for the duration of each flyover. The narrowband spectra were then integrated to obtain one-third octave band spectra. These one-third octave spectra were then de-propagated to create the noise semi-spheres for use in RNM. Additionally, the one-third octave spectra were integrated to create Overall Sound Power Levels (OASPL) semi-spheres. Additionally, one-third octave spectra were filtered and integrated to obtain A-weighted Overall Sound Power Levels (L_A or dBA) semi-spheres. Aircraft position and weather data were also processed and included in this report. The formats for these data are described in a following section.

Source Noise Sample Results

Presented in figure 13 is a typical weather plot showing a 4-hour period on one day of testing. Data are shown to an altitude of 300 feet. These plots show the typical weather variation for temperature, wind direction and wind speed for a test period.

The OASPL from the centerline microphone for level flight at multiple airspeeds for both the MD-902 and Mi-8M is shown in figure 14. The general trend for peak amplitude variation is the same for both aircraft but the details in the shapes are different. The MD-902 has a broader peak at the overhead position with a double peak for 60 to 120 knots. However, the Mi-8M has a consistently sharper peak at this overhead position. This could possibly be due to the NOTAR configuration of the MD-902.

OASPL semi-spheres from the MD-902 and Mi-8M aircraft for low and high airspeeds are shown in figure 15 through 18. The OASPL were computed from one-third octave band spectra. To illustrate the significant variations in the noise directivity characteristics of rotorcraft, plots of the time history and narrowband spectra at several points on the semi-sphere are provided. Note that the main rotor advancing blade side switches from starboard to port for the two aircraft since the MD-902 main rotor has a counterclockwise rotation while the Mi-8M main rotor has a clockwise rotation.

Propagation

Propagation Test Instrumentation

Noise Propagation data were acquired to help understand atmospheric effects. The test used propane cannons as impulsive noise sources, a resonator for a low frequency tonal source and a weather balloon system to profile the atmosphere up to 2700 feet altitude. Figure 19 provides a photograph of each of these systems while Figure 20 shows the experimental layout. Data were acquired on two days separated by one week. The test setup consisted of up to 11 WAMS units in a linear array that spanned about 5 miles, with the tethered weather balloon system located near one end of the array. Propane cannons were positioned at each end of the array and, for the second test day, a third cannon was deployed near the middle of the array. The propagation test layout is shown in figure 20 with the yellow pins indicating the microphone locations for both days of testing and the green pins indicating the additional microphones used for the second day of testing. Table 18 shows the GPS coordinates and separation distances for the microphones and cannons. During a data run each cannon was fired every two seconds for two minutes and then an in-house designed and built 17-Hz resonator located near the cannon 1 position was activated for two minutes. The weather balloon collected data from the ground up to 2700 feet continuously during propagation data acquisition. The sequence of cannon firing and resonator activation was repeated approximately every 30 minutes from 6 AM to 11 AM on each test day to encompass a range of atmospheric conditions. The first day of testing had eight microphones and two cannons. Using lessons learned from the first day of testing, an additional three microphones and a third cannon location were added for the second day of testing. Table 19 is the run log for the two days of propagation testing.

Propagation Data Reduction

The propagation test microphone data were converted to engineering units and provided to the National Center for Physical Acoustics at the University of Mississippi for preliminary analysis. This acoustic data will be merged with the weather data and has been reported in the 2009 Military Sensing Symposia [ref 7]. The microphone and weather data are included in the electronically available data set, in a format that is explained in a following section.

Propagation Sample Results

Presented are data from the first day of propagation testing. Figure 21 shows the temperature from the ground to 2000 feet altitude for data taken at 0710, 0735 and 0945. Note the slight temperature inversion during the earlier profiles and the more common daytime lapse profile at 0945. Figure 22 shows the attenuation relative to microphone 1 for the signal generated by cannon 1. Note the significantly elevated noise levels at about 20,000 feet compared to all other propagation distances during the early morning hours. This data clearly shows the significant effect that the atmospheric conditions have on sound propagation.

Perception Test

Audibility data were acquired for the MD-902 and Mi-8M using the sound jury technique. The sound jury consisted of 12 individuals at one location. They were isolated in canvas booths such that they could not see the aircraft or each other (figure 23). The jurors used a switch that indicated when they could not hear, thought they might hear, or definitely could hear the aircraft. Weather data were continuously profiled during these runs using the same 2700-ft max altitude tethered balloon system used during the propagation testing. Two wireless microphones acquired acoustic pressure time history data; one on a ground board and one on a tripod set at 1.2M height. Additionally, a head and torso simulator with a microphone mounted in each ear was also located at the sound jury site. The aircraft would fly a rosette pattern that approached the sound jury from different directions. This was repeated for two airspeeds. Figure 24 shows the flight pattern used for the perception testing. The aircraft would fly from position 1 to 2 at the specified test condition, transition to 3, fly 3 to 4 at the specified test condition, transition to 5, etc. Positions 1 thru 5 were set sufficiently far from the Sound Jury as to be inaudible. Sound jury data were taken for the MD-902 aircraft at 80 and 120 knots, 150 ft AGL and for the Mi-8M at 110 and 220 kph, 150 ft AGL. The data log for the MD-900 is contained in table 20 and for the Mi-8M in Table 21.

The perception test acoustic, weather, aircraft position and aircraft state data were provided to the ARL's Survivability/Lethality Analysis Directorate (ARL-SLAD) for merging with the ARL acquired sound jury data. The sound jury perception data is not contained in the NASA database and can be obtained from John Williams of the Army Research Laboratory's SLAD (john.williams1@us.army.mil). The acoustic, weather and aircraft electronic data are included in the electronically available data set.

Electronic Data

Data described in this paper are open and available electronically upon request from Michael Watts, Aeroacoustics Branch (D314), Mail Stop 461, NASA Langley Research Center, 23681, Michael.e.watts@nasa.gov. The data are provided in standard ASCII and/or Network Common Data Form (NetCDF) format, depending on file size. NetCDF is a self-describing packed binary format that is platform independent. Drivers for a multitude of platforms are available at no cost at

http://www.unidata.ucar.edu/software/netcdf/. The file structure for the electronic data is shown in figure 25. Each aircraft and the propagation test have a directory and the subdirectories within each directory are similar. Descriptions of the contents of each specific subdirectory, including file naming convention and file format, are contained in the following subsections.

Acoustic Pressure Time History Data

Acoustic pressure time history data, in units of pascals, are contained in the "source_pressure_data" subdirectory. These are NetCDF binary files. There is one file per microphone with the file name being the 3 Digit Flight Code + 3 Digit Run Number + '_' + 2 Digit Microphone Number + '_pascal.nc'. For example, file 100202_08_pascal.nc is the file containing the acoustic pressure time history data in pascals for flight code 100, run number 202, microphone number 8. The header portion of an ncdump (a program provided with the NetCDF software) output of one of these files is shown in figure 26. A plot of the first 5000 points from file 100202_08_pascal.nc is shown in figure 27. This format is consistent for all pressure time history NetCDF files. Differences with the pressure time history files acquired during the source, propagation and perception testing are the coordinate system definition and the overhead time. The coordinate system for each type of data is specified in the description for that testing. The overhead time value for the source noise testing is the seconds from midnight when the aircraft was over the center microphone. The overhead time value was set to the point of closest approach to the sound jury for the perception test and to zero for the propagation test.

Narrowband Data

The narrowband spectra created from the time histories used in the generation of the semi-spheres is included in the electronic data in the "spectra –> narrowband" subdirectory and are in NetCDF format. There is one file per microphone with the file name being the 3 Digit Flight Code + 3 Digit Run Number + '_' + 2 Digit Microphone Number + '_nbd3.nc'. For example, file 100202_08_nbd3.nc is the file containing the narrowband data in dB for flight code 100, run number 202, microphone number 8. A description of listing for this type of file is shown in figure 28. Figure 29 shows the first spectrum from file 100202_08_nbd3.nc.

One-Third Octave Band Data

The one-third octave spectra created from the narrowband data used in the generation of the semi-spheres is included in the electronic data in the "spectra –> third-octave" subdirectory and are in ASCII format as shown in figure 30 (header only). The columns are spectra number (SP#), center time of the spectral average, F (not used), A (not used), and the one-third octave band number. The data values are in centibels (10 times the decibel value). There is one file per microphone with the file name being the 3 Digit Flight Code + 3 Digit Run Number + '_' + 2 Digit Microphone Number + '_thr.nc'. For example, file 100202_08_thr.nc is the file containing the one-third octave data in dB for flight code 100, run number 202, microphone number 8.

Semi-sphere One-Third Octave Band Data

The one-third octave band semi-spheres for all source noise data points are included in the electronic data set in the "semispheres" subdirectory and are in NetCDF format. There is one file per run number with the file name being the "MD902" or "MI-08" + 3 Digit Run Number + '.nc'. For example, file MD902202.nc is the file containing the semi-sphere for the MD-902 for run number 202. These files are

standard RNM files in NetCDF format. The ncdump header of this file is contained in figure 31. Examples of the contents of these files are shown in the hemisphere portion of figures 15 thru 18.

Aircraft data

Aircraft position and state data are contained in space delaminated ASCII files in the “tracking” subdirectory with a data point every 0.2 seconds. Each file contains Time, X, Y, Z, Vkts, Heading1, Roll, Pitch, Heading2 data. Time is the UTC local time in seconds from midnight. X, Y, and Z are the aircraft location obtained from the differential GPS system in feet. The data format is shown in figure 32. There is one file per data point with the file name being the 3 Digit Flight Code + 3 Digit Run Number + ‘.trk’. For example, file 100202.trk is the file containing the tracking data for flight code 100, run number 202.

The reference for the coordinates system for each specific type of data is explained in the specific section describing that type of testing. The Vkts variable is the ground speed derived from the vehicle position data. Heading1 is the ground track heading referenced to magnetic north, in degrees. Roll, Pitch and Heading2 are the aircraft attitudes and heading as measured by the on board inertial system, where heading is again referenced to magnetic north, in degrees.

Weather System Data

Weather data were obtained from two sources during the testing. The NASA weather balloon system was used during the source noise testing and the Ole Miss weather balloon system was used during the propagation and perception tests. Data files from both sources are provided in ASCII file format. The NASA weather data is contained in the “weather –> NASA” subdirectory and the Ole Miss data is in the “weather –> OleMiss” subdirectory. All weather data files have the file name format of YYYYMMDD + ‘_’ + HHMM + ‘-“ + HHMM + ‘.txt’ where the sections are the date, start of data time and end of data times. For example ‘20070819_0627-0658.txt’ are the weather data obtained on August 19, 2007 between the local time of 6:27 and 6:58 AM. The file contents for the NASA data are described in figure 33 and the Ole Miss data in figure 34.

Summary

An acoustic flight test of the MD-902 and Mi-8M helicopters was performed at Eglin AFB during August/September 2007. Acoustic pressure data were obtained from a U shaped array of microphones and sound semi-spheres were generated from that data for a variety of test conditions. These test conditions included level flight speed sweeps as well as departures and descents at a range of speeds and descent angles. Perception testing was also performed on these aircraft by flying the aircraft in the presence of a sound jury and measuring when they could hear the vehicles. Additionally, propagation data were acquired from a linear array of microphones that spanned 5 miles and measured the atmospheric effects of noise generated by a propane cannon. The acoustic and aircraft data are available in electronic form upon request.

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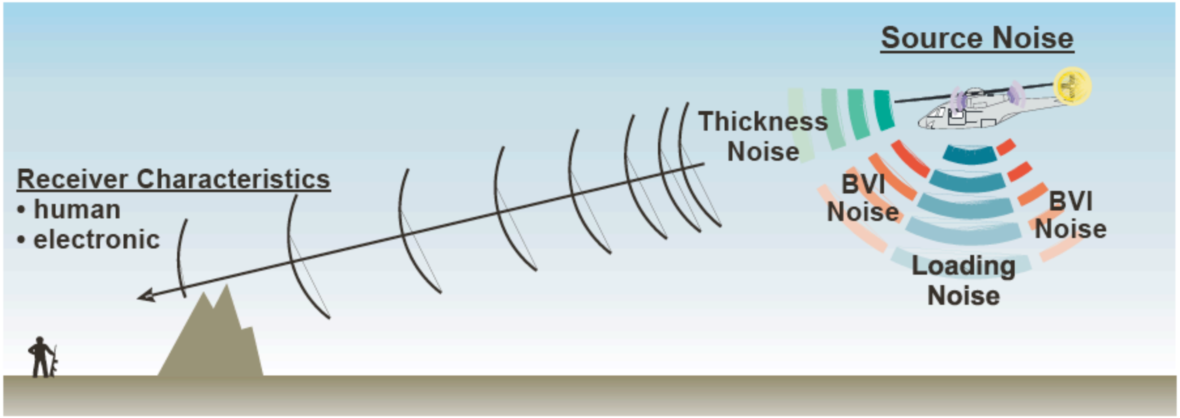

Figure 1. Rotorcraft acoustics issues.

Figure 2. MD-902 aircraft

Table 1. MD-902 Specifications

Main Rotor Diameter	33.83 ft
Number Main Rotor Blades	5
Main Rotor RPM, Blade Passage Freq.	392 RPM, 32.7 Hz
NOTAR Fan RPM, Blade Passage Freq.	5412 RPM, 1100 Hz
Power Plant	2xPW207E, 640 shp each
Empty Weight	1,975 lb
Max Take Off Gross Weight	6,250 lb
Max Speed	152 kts

Figure 3. Mi-8M aircraft

Table 2. Mi-8M Specifications

Main Rotor Diameter	69.86 ft
Number Main Rotor Blades	5
Main Rotor RPM, Blade Passage Freq.	192 RPM, 16 Hz
Tail Rotor Diameter	12.82 ft
Number Tail Rotor Blades	3
Tail Rotor RPM, Blade Passage Freq.	1120 RPM, 56 Hz
Power Plant	2xTV3-117VM, 2225 shp each
Empty Weight	15,700 lb
Max Take Off Gross Weight	28,700 lb
Max Speed	135 kts

Figure 4. GPS instrtumentation package installed in MD-902 passenger compartment

Figure 5. Flight test engineer station in MD-902

Figure 6. Pilot guidance instrument


Figure 7. Microphones mounted on ladder suspended from crane

Figure 8. Arial view of source noise test settup

Figure 9. Source noise instrumentation

Figure 10. Wireless acoustic microphone system (WAMS)

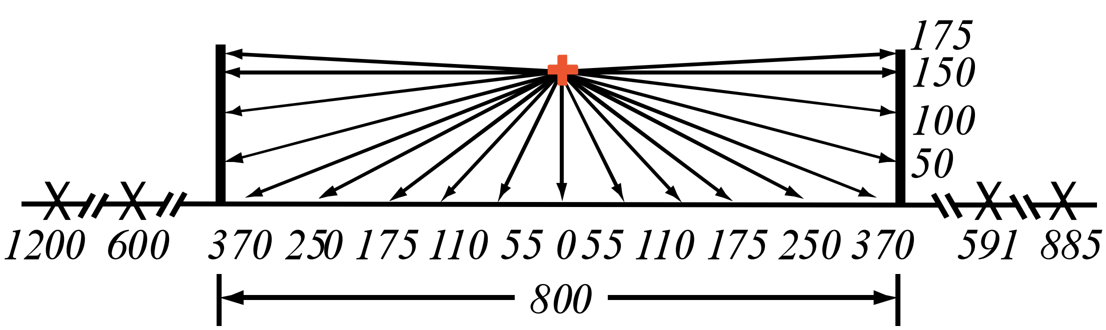

Figure 11. Source noise microphone layout

Table 3. Source noise microphone locations

Mic #	X, ft.	Y, ft.	Z, ft.	Angle, deg	Mic Type	Comments
1	0	401.67	175	93.6	4134 (4189)	Crane
2	0	401.67	150	90.0	4134 (4189)	Crane
3	0	401.67	100	82.9	4134 (4189)	Crane
4	0	401.67	50	76.0	4134 (4189)	Crane
5	0	370.5	0	68.0	4134	Groundboard
6	0	250.62	0	59.1	4134	Groundboard
7	0	175.22	0	49.4	4134	Groundboard
8	0	110.46	0	36.4	4134	Groundboard
9	0	55.11	0	20.2	4134	Groundboard
10	0	0	0	0.0	4134	**Groundboard Reference**
11	0	-55.11	0	-20.2	4134	Groundboard
12	0	-110.46	0	-36.4	4134	Groundboard
13	0	-175.22	0	-49.4	4134	Groundboard
14	0	-250.62	0	-59.1	4134	Groundboard
15	0	-370.5	0	-68.0	4134	Groundboard
16	0	-401.89	50	-76.0	4134 (4189)	Crane
17	0	-401.89	100	-82.9	4134 (4189)	Crane
18	0	-401.89	150	-90.0	4134 (4189)	Crane
19	0	-401.89	175	-93.6	4134 (4189)	Crane
20	-49.96	0	32.8	0.0	4134 (4189)	10M Pole
21	0	1200.77	0	82.9	4189	Groundboard Wireless
22	0	599.81	0	76.0	4189	Groundboard Wireless
23	0	-591.15	0	-75.8	4189	Groundboard Wireless
24	0	-885.25	0	-80.4	4189	Groundboard Wireless

Table 4. MD-902/MI-8M* level flight, approach and hover number of test points

kts./deg.	0	3	6	9	12
0	9/10				
40	5/4	4/4	2/3	2/2	2/3
60	7/4	3/4	3/3	3/2	2/4
80	7/4	4/3	3/3	2/4	
100	12/13	-/3	-/3		
110	-/4				
120	7/4				
Vmax	7/3				

*Mi-8M is in nearest knots box as data run IAS was prescribed in kph

Table 5. MD-902/Mi-8M* departure number of test points.

kts.	500 ft/mn ROC
40	-/3
50	3/-
60	-/2
70	3/-
80	-/2
90	4/-
100	-/2

*Mi-8M is in nearest knots box as data run IAS was prescribed in kph

Table 6. MD-902 steady state circular flight number of test points.

Bank Ang.	Turn Dir.	60 kts.	80 kts.
15	Left	1	
	Right	1	
30	Left	1	2
	Right	1	1
45	Left	1	2
	Right	1	1

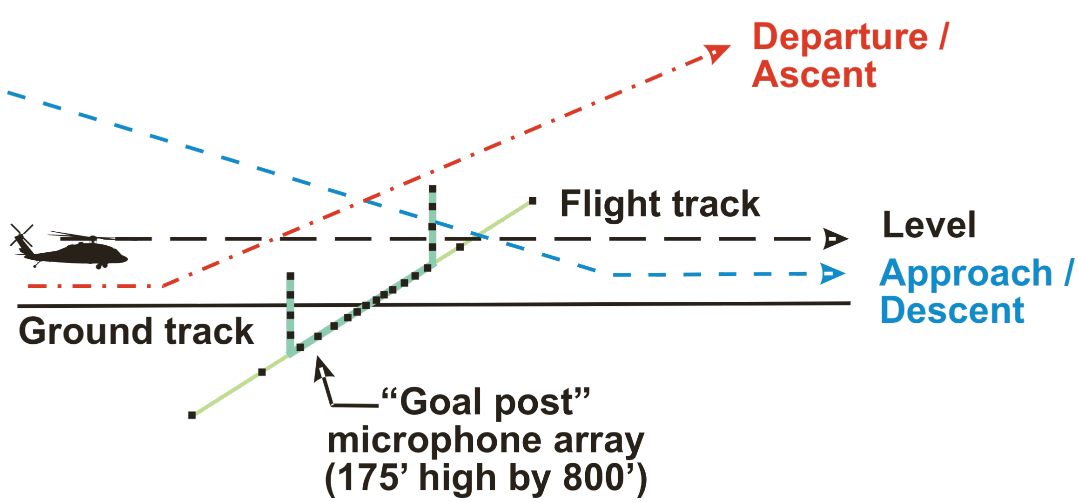

Figure 12. Notional source noise flight paths (level, approach and departure)

Table 7. MD-902 Source Noise Level Flight Test Points

Flight Code	Run Number	Target KIAS	Flight Number	Test Date	Data On Time	Average Aircraft Speed, kts	Average Y, ft	Std. Dev. Y, ft	Average Altitude, ft	Std. Dev., Altitude, ft	Average ROC, ft/min	Aircraft OAT, deg C	Q	Fuel Rem, lbs	Aircraft GW, lbs	Data Start Range, ft	Data End Range, ft	Comments
100	202	100	3290	8/20/07	7:15:48	97	2.8	3.9	152.6	6.1	22	24	57	718	5981	-3000	3000	Housekeeping
100	203	60	3290	8/20/07	7:20:42	68	2.8	4.2	153.7	4.4	-4	24	48	675	5938	-3000	3000	WS 3 kts good point, 1 & 4 better now
100	204	80	3290	8/20/07	7:25:40	84	-1.7	5.0	151.9	3.8	8	25	48	655	5918	-3000	3000	WS 3 kts good point
100	205	120	3290	8/20/07	7:30:25	118	6.6	6.0	154.6	7.6	9	25	73	615	5878	-3000	3000	WS 4 kts good point, avg speed 115 kts
100	206	130	3290	8/20/07	7:34:30	134	9.4	6.9	152.7	6.1	8	26	95	587	5850	-3000	3000	WS 4 kts good point, 130 IAS
100	207	40	3290	8/20/07	07:38.5	44	4.0	4.0	151.5	2.0	6	24	50	540	5803	-3000	3000	WS 6 kts good points
101	223	100	3291	8/21/07	6:48:22	101	-1.8	2.6	149.2	3.3	-2	26	60	710	5973	-3000	3000	Housekeeping WS 7 kts,
101	235	100	3291	8/21/07	8:03:50	100	0.7	3.2	145.3	6.0	-4	27	56	200	5463	-3000	3000	Housekeeping – low freq jet noise in and out
101	236	100	3291	8/21/07	8:34:44	103	-0.9	2.5	147.1	4.1	8	29	61	915	6178	-3000	3000	Housekeeping – air quality a little worse, as expected, but still pretty good
101	238	60	3291	8/21/07	8:43:35	68	-0.2	3.3	142.8	4.3	-4	29	51	824	6087	-3000	3000	
101	239	60	3291	8/21/07	8:48:46	67	3.2	5.4	146.9	4.3	5	29	50	787	6050	-3000	3000	
101	240	80	3291	8/21/07	8:53:37	87	5.9	9.9	151.6	5.9	3	29	56	758	6021	-3000	3000	
101	241	80	3291	8/21/07	8:58:22	88	0.4	5.6	152.1	4.9	1	29	56	755	6018	-3000	3000	
101	242	120	3291	8/21/07	9:02:46	122	1.7	5.5	143.4	10.8	-4	30	79	731	5994	-3000	3000	
101	243	120	3291	8/21/07	9:06:42	124	1.7	4.7	151.1	5.7	-11	30	79	685	5948	-3000	3000	
101	244	130	3291	8/21/07	9:10:36	133	-0.3	7.0	155.3	4.3	-23	30	92	668	5931	-3000	3000	130 IAS
101	245	130	3291	8/21/07	9:14:32	130	4.7	5.4	150.4	6.5	51	30	91	629	5892	-3000	3000	
101	246	40	3291	8/21/07	9:19:05	46	3.1	7.4	148.5	5.4	-2	29	50	559	5822	-3000	3000	
102	248	100	4031	8/23/07	6:42:48	108	-0.1	4.8	149.6	2.7	17	27	62	908	6171	-3000	3000	Housekeeping, WS 3 kts
102	269	100	4031	8/23/07	8:01:45	105	-0.1	3.3	145.0	3.7	-16	27	60	362	5625	-3000	3000	Housekeeping, WS 3 kts, 19,71 good
102	270	100	4031	8/23/07	8:49:30	107	-2.9	3.8	146.2	5.9	-12	29	63	972	6235	-3000	3000	Housekeeping, WS 4 kts, 19,71 good
102	271	60	4031	8/23/07	8:54:14	70	1.8	4.1	148.7	2.8	-9	28	52	968	6231	-3000	3000	WS 3 kts, 19,71 good
102	272	80	4031	8/23/07	8:59:11	89	-2.0	4.5	146.6	3.7	-8	29	52	920	6183	-3000	3000	WS 3 kts, 19,71 good
102	273	120	4031	8/23/07	9:03:37	125	-0.4	6.4	147.9	4.9	-18	29	81	894	6157	-3000	3000	WS 3-4 kts, 19,71 good
102	274	130	4031	8/23/07	9:07:32	136	8.9	6.7	149.9	4.0	15	29	91	878	6141	-3000	3000	WS 3 kts, 19,71 good
102	275	40	4031	8/23/07	9:12:00	50	2.3	3.4	150.7	4.5	1	28	55	800	6063	-3000	3000	WS 3-6 kts, 19,71 good
103	282	100	3528	8/24/07	6:42:19	104	2.3	3.1	147.9	2.6	11	27	56	788	6051	-3000	3000	Housekeeping, WS 0 kts
103	296	60	3528	8/24/07	7:39:02	66	3.0	3.6	151.6	4.0	-10	26	46	403	5666	-3000	3000	WS 2-3 kts, 19,71 good
103	297	80	3528	8/24/07	7:44:05	85	2.1	3.2	151.6	2.8	-5	26	49	379	5642	-3000	3000	WS 3 kts, 19,71 good
103	298	120	3528	8/24/07	7:48:47	120	4.7	3.4	151.1	5.8	1	27	71	324	5587	-3000	3000	WS 3 kts, 19,71 good
103	299	130	3528	8/24/07	7:52:45	131	2.9	5.6	151.1	6.6	31	27	90	289	5552	-3000	3000	WS 3 kts, 19,71 good
103	300	100	3528	8/24/07	7:58:16	102	2.2	4.3	148.2	5.1	8	27	54	263	5526	-3000	3000	Housekeeping, WS 3 kts, ac taking off during run
103	301	60	3528	8/24/07	8:33:31	68	3.3	4.2	147.2	3.3	16	28	50	963	6226	-3000	3000	WS 3 kts, N-S
103	302	60	3528	8/24/07	8:36:40	60	-7.3	7.8	152.6	3.2	-4	28	50	937	6200	3000	-3000	S-N
103	303	100	3528	8/24/07	8:39:37	102	1.5	6.7	150.4	5.4	11	29	60	936	6199	-3000	3000	Housekeeping, N-S, WS 4 kts
103	304	100	3528	8/24/07	8:42:14	94	-0.1	5.8	153.9	2.7	6	29	61	923	6186	3000	-3000	Housekeeping, S-N, WS 5 kts
103	305	80	3528	8/24/07	8:44:54	88	-0.2	4.3	151.6	3.4	1	29	52	899	6162	-3000	3000	WS 4-5 kts, N-S
103	306	80	3528	8/24/07	8:47:21	77	-2.6	7.8	151.9	2.1	-4	29	53	886	6149	3000	-3000	WS 5 kts, S-N
103	307	120	3528	8/24/07	8:50:06	125	4.2	9.1	151.0	5.1	14	30	85	868	6131	-3000	3000	WS 3-5 kts, N-S
103	308	120	3528	8/24/07	8:52:25	117	-9.1	5.0	153.3	4.6	-5	30	82	859	6122	3000	-3000	S-N, WS 3-4 kts
103	309	130	3528	8/24/07	8:55:16	132	-1.7	4.0	150.6	6.1	19	30	90	836	6099	-3000	3000	N-S, 128 KIAS, WS 3-4 kts
103	310	130	3528	8/24/07	8:57:58	122	-8.3	9.7	158.8	4.5	7	30	90	809	6072	3000	-3000	S-N, WS 3 kts
103	311	40	3528	8/24/07	9:00:28	50	1.6	5.1	150.9	2.6	6	29	51	748	6011	-3000	3000	N-S, WS 3 kts, stowed flag at crane before this run
103	312	40	3528	8/24/07	9:04:15	39	-11.2	10.7	151.5	2.9	-1	29	51	730	5993	3000	-3000	S-N, WS 4-6 kts
103	313	100	3528	8/24/07	9:08:32	102	1.1	4.5	153.9	4.1	7	30	62	726	5989	-3000	3000	N-S, WS 3-5 kts

Table 8. MD-902 Source Noise Approach Flight Test Points

Flight Code	Run Number	Target KIAS	Target GS, deg	Target ROC, ft/min	Flight #	Test Date	Data On Time	Average Aircraft Speed, kts	Altitude over Center, ft.	Average GS, deg	Average ROC, ft/min	Aircraft OAT, deg C	Q	Fuel Rem, lbs	Aircraft GW, lbs	Data Start Range, ft	Data End Range, ft	Comments
100	208	80	3	-425	3290	8/20/07	7:46:00	82.1	174.5	2.73	-394	26	40	500	5763	-5890	2000	Pull out 100 ft, WS 7 kts
100	209	80	3	-425	3290	8/20/07	7:50:49	83.6	208.4	3.33	-491	26	42	469	5732	-6200	2000	Pull out 100 ft, WS 4 kts
100	210	60	3	-318	3290	8/20/07	7:55:42	64.8	197.5	3.02	-346	26	37	430	5693	-6200	2400	Pull out 70 ft, WS 6 kts, explosions at beginning of run
100	211	40	3	-212	3290	8/20/07	8:06:37	44.3	235.7	3.01	-236	26	45	383	5646	-6200	2200	WS 7 kts
100	212	80	6	-848	3290	8/20/07	8:12:47	78.7	214.3	5.78	-799	27	35	333	5596	-7400	1400	WS 9-13 kts
100	213	60	6	-636	3290	8/20/07	8:18:10	57.6	209.4	6.03	-612	25	35	309	5572	-7400	1200	WS 10 kts
100	216	60	9	-952	3290	8/20/07	9:43:26	52.9	208.3	9.03	-839	27	32	810	6073	-9000	800	WS 10 kts, V19 now working
100	222	40	3	-212	3290	8/20/07	10:11:40	38.3	204.6	3.13	-211	28	51	611	5874	-9000	2000	WS 8 kts, 8 acting up
101	224	60	3	-318	3291	8/21/07	6:53:37	63.6	203.6	3.01	-337	28	38	642	5905	-6400	2200	Very low (0-2) gnd wds, real clean run, great air quality
101	225	80	3	-425	3291	8/21/07	6:58:55	83.0	207.9	3.13	-459	28	37	632	5895	-8400	2200	Great run
101	226	40	6	-424	3291	8/21/07	7:04:52	41.7	202	6.02	-442	26	42	585	5848	-8800	1200	
101	227	60	6	-636	3291	8/21/07	7:11:21	61.6	208.1	6.16	-669	28	36	535	5798	-8200	1200	
101	228	80	6	-848	3291	8/21/07	7:16:24	81.1	202.6	6.11	-874	28	36	519	5782	-8800	1000	
101	229	40	9	-634	3291	8/21/07	7:22:25	39.4	208	8.79	-608	27	38	466	5729	-9800	800	
101	230	60	9	-952	3291	8/21/07	7:28:52	59.0	205.4	9.28	-963	26	28	437	5700	-10500	800	
101	231	80	9	-1269	3291	8/21/07	7:34:25	80.3	204.6	9.07	-1280	28	28	408	5671	-7800	800	
101	232	40	12	-843	3291	8/21/07	7:40:32	38.7	213.3	11.69	-793	26	34	362	5625	-9800	800	
101	233	60	12	-1263	3291	8/21/07	7:47:02	58.6	216.8	12.21	-1253	27	20	327	5590	-10500	600	
101	234	40	3	-212	3291	8/21/07	7:55:04	43.5	202.1	3.38	-260	27	42	281	5544	-8000	2000	
102	249	80	3	-425	4031	8/23/07	6:47:40	90.9	201.1	3.11	-495	28	37	849	6112	-6000	2000	WS 3 kts,
102	250	60	3	-318	4031	8/23/07	6:52:00	71.8	205.6	3.12	-396	27	36	820	6083	-8000	2000	WS 3 kts
102	251	40	3	-212	4031	8/23/07	6:56:56	52.1	203.9	3.18	-292			790	6053	-7800	2000	WS 3 kts, 19,71 good
102	252	80	6	-848	4031	8/23/07	7:02:56	89.2	211.5	6	-943	28	28	750	6013	-9000	1200	WS 3 kts
102	253	60	6	-636	4031	8/23/07	7:07:36	68.5	208.4	6.16	-743	28	32	710	5973	-10500	1200	WS 3 kts, 19, 71 good, late data on at 4700 ft
102	254	40	6	-424	4031	8/23/07	7:13:30	49.6	204.1	6.03	-527	28	37	661	5924	-10300	1200	Late data on call at 4500 ft, WS 3 kts, 19,71 good
102	255	60	9	-952	4031	8/23/07	7:19:13	71.0	195.4	8.95	-1117	28	26	646	5909	-7200	600	WS 3 kts, 19,71 good
102	256	80	9	-1269	4031	8/23/07	7:24:07	90.3	219.5	9.31	-1475	29	25	617	5880	-8500	600	WS 3-4 kts, 19,71 good
102	257	40	9	-634	4031	8/23/07	7:29:26	49.4	214.2	8.8	-765	29	33	573	5836	-8000	1000	WS 3-4 kts, 19,71 good
102	258	60	12	-1263	4031	8/23/07	7:35:11	65.7	206.5	11.96	-1376	28	20	539	5802	-9600	600	WS 4 kts, (aloft 325, 13 kts, 250ft)
102	259	40	12	-843	4031	8/23/07	7:40:50	47.8	213.1	12	-1004	29	25	503	5766	-9600	600	WS 2-4 kts, 19,71 good

Table 9. MD-902 Source Noise Departure Flight Test Points

Flight Code	Run Number	Target KIAS	Target ROC, ft/min	Flight #	Test Date	Data On Time	Average Aircraft Speed, kts	Altitude over Center, ft.	Average ROC, ft/min	Aircraft OAT, deg C	Q	Fuel Rem, lbs	Aircraft GW, lbs	Data Start Range, ft	Data End Range, ft	Comments
100	218	90	500	3290	8/20/07	9:52:33	86	170.7	561	28	67	760	6023	-1000	6400	Practice run V19 ?
100	219	90	500	3290	8/20/07	9:56:40	85	89.1	511	28	67	723	5986	-400	6500	WS 10 kts
100	220	70	500	3290	8/20/07	10:00:45	66	162.6	411	29	63	690	5953	-1000	6400	WS 9 kts, 165 ft
100	221	50	500	3290	8/20/07	10:05:00	45	192.8	443	29	55	672	5935	-1000	6000	WS 9 kts
102	276	90	500	4031	8/23/07	9:16:50	99	129.4	470	29	67	760	6023	-1000	7000	WS 6-8 kts, 125 ft over center mic
102	278	70	500	4031	8/23/07	9:23:43	80	170.3	434	29	53	725	5988	-800	5400	WS 5-6 kts, 178 ft
102	279	70	500	4031	8/23/07	9:27:00	79	164.3	512	29	55	716	5979	-800	5200	WS 5 kts, 172 ft
102	280	50	500	4031	8/23/07	9:30:23	58	194.4	434	29	55	671	5934	-800	5000	WS 5-8 kts, 197 ft, explosions just after overhead, possible jets in area
102	281	50	500	4031	8/23/07	9:34:23	58	180.9	414	29	54	650	5913	-800	5000	WS 4-8 kts, 185 ft

Table 10. MD-902 Source Noise Hover Flight Test Points

Flight Code	Run Number	Target Heading , deg	Flight Number	Test Date	Data On Time	Average Y, ft	Std. Dev. Y, ft	Average Altitude, ft	Std. Dev., Altitude, ft	Average Heading , deg	Aircraft OAT, deg C	Q	Fuel Rem, lbs	Aircraft GW, lbs	Comments
102	260	180	4031	8/23/07	7:46:00	2.6	5.1	7.2	150.2	177.6	27	80	460	5723	400 ft offset, WS 3 kts, mic 8 acting up
102	261	225	4031	8/23/07	7:47:23	1.0	-1.3	6.8	153.1	226.0	27	80	450	5713	400 ft offset, WS 2 kts. Mic 8 acting up
102	262	270	4031	8/23/07	7:48:50	1.4	-66.7	17.9	150.1	265.4	27	80	430	5693	400 ft offset WS 3 kts, 19,71 good
102	263	315	4031	8/23/07	7:50:09	1.6	-149.7	5.8	152.6	308.0	27	80	407	5670	400 ft offset abort
102	264	315	4031	8/23/07	7:51:18	1.0	-10.6	3.0	151.3	309.1	27	80	407	5670	400 ft offset, WS 3 kts, 19,71 good
102	265	0	4031	8/23/07	7:52:47	1.0	1.0	3.1	147.1	354.5	27	71	404	5667	400 ft offset, WS 1-3 kt , 19,71 good
102	266	45	4031	8/23/07	7:55:10	0.9	21.4	8.9	147.1	38.2	27	75	378	5641	400 ft offset, WS 2-3 kts,
102	267	90	4031	8/23/07	7:56:51	1.1	9.0	4.6	149.9	87.0	27	77	372	5635	400 ft offset, WS 3 kts, 19,71 good
102	268	135	4031	8/23/07	7:58:10	0.9	-0.4	4.2	150.7	130.3	27	76	360	5623	400 ft offset, WS 3 kts

Table 11. MD-902 Source Noise Maneuver Flight Test Points

Flight Code	Run Number	Target KIAS	Target Bank Angle, deg	Flight #	Test Date	Data On Time	Average Aircraft Speed, kts	Average Altitude, ft.	Std. Dev., Altitude, ft	Average Bank Angle, deg	Aircraft OAT, deg C	Q	Fuel Rem, lbs	Aircraft GW, lbs	Comments
103	283	60	15	3528	8/24/07	6:47:03	63	254.0	4.4	15.1	27	51	726	5989	Right Turn, 8kt 150 ft 70 deg, 250 ft 7kts 40 deg, 0 kts grd
103	284	60	-15	3528	8/24/07	6:55:35	64	251.0	7.2	-13.9	27	53	678	5941	Left Turn, WS 0 kts grd
103	285	60	30	3528	8/24/07	7:00:00	66	258.6	9.3	27.7	28	54	651	5914	Right Turn, initiated turn a little late
103	286	60	-30	3528	8/24/07	7:04:57	64	261.2	12.6	-29.3	28	57	661	5924	Left Turn, WS 0 kts grd
103	287	60	45	3528	8/24/07	7:08:32	64	249.8	11.5	43.2	28	61	630	5893	Right Turn, WS 0 kts grd
103	288	60	-45	3528	8/24/07	7:11:27	65	265.2	18.0	-34.5	28	59	588	5851	Left Turn abort and repeat
103	289	60	-45	3528	8/24/07	7:13:59	64	259.6	13.7	-40.8	28	60	562	5825	Left Turn, WS 0 kts
103	290	80	30	3528	8/24/07	7:17:06	81	256.5	10.9	31.6	27	60	540	5803	Right Turn, WS 0 kts
103	291	80	45	3528	8/24/07	7:20:56	82	258.6	31.4	42.1	27	65	506	5769	Right Turn, low on first revolution, WS 0 kts
103	292	80	-30	3528	8/24/07	7:24:32	83	250.8	8.9	-30.4	27	59	497	5760	Left Turn
103	293	80	-30	3528	8/24/07	7:27:59	83	252.6	9.9	-30.8	27	62	473	5736	Left Turn, WS 0 kts
103	294	80	-45	3528	8/24/07	7:31:24	86	311.8	50.7	-37.1	27	66	460	5723	Left Turn, abort try again
103	295	80	-45	3528	8/24/07	7:34:16	84	256.6	10.1	-40.9	27	68	436	5699	Left Turn, WS 3 kts, AC comment good condition

Table 12. Mi-8M Source Noise Level Flight Test Points

Flight Code	Run Number	Target KIAS	Flight Number	Test Date	Data On Time	Average Aircraft Speed, kts	Average Y, ft	Std. Dev. Y, ft	Average Altitude, ft	Std. Dev., Altitude, ft	Average ROC, ft/min	Aircraft OAT, deg C	Collective Angle, deg	EPR	PTIT, deg C	Fuel Rem, lbs	Aircraft GW, lbs	Data Start Range, ft	Data End Range, ft	Comments
300	501	97	4214	9/4/07	6:57:22	107	-5.0	11.0	141.7	10.5	-67	26	8	5.6	775	4132	23217	-3000	3000	Housekeeping, WS 3 kts, 19,71 good
300	502	97	4214	9/4/07	7:02:33	103	0.2	9.1	145.8	4.6	10	26	6.8	5.1	730			-3000	3000	Housekeeping, WS 3 kts, 19,71 good
300	503	37	4214	9/4/07	7:08:18	51	7.2	10.6	143.4	4.5	6	25	6.2	5.1	720			-3000	3000	WS 3 kts, 19,6-71 drop offline
300	504	37	4214	9/4/07	7:16:11	50	6.4	8.9	142.5	3.2	0	25	6	5.1				-3000	3000	WS 3 kts, 9and10-19, 6-71 drop offline
300	505	59	4214	9/4/07	7:24:08	68	13.2	10.5	144.5	3.8	12	25	5.8	5.1				-3000	3000	WS 3 kts, 19,71 good
300	506	59	4214	9/4/07	7:30:44	69	5.8	9.7	145.3	4.4	28	25	6	5.1	710			-3000	3000	WS 5 kts, 19,71 good
300	507	80	4214	9/4/07	7:36:48	86	4.7	14.8	148.9	7.0	-5	25	6	5.1	710			-3000	3000	WS 3-6 kts, 19,71 good
300	508	80	4214	9/4/07	7:42:11	92	9.6	9.4	147.8	2.0	-1	26	6.1	5.1	720			-3000	3000	WS 3-5 kts, 19,71 good
300	509	107	4214	9/4/07	7:47:34	112	6.7	7.6	143.5	4.7	14	27	7.2	5.5	740			-3000	3000	WS 3-5 kts, 19,71 good
300	510	107	4214	9/4/07	7:52:31	113	6.1	3.9	143.9	6.0	43	27	7.2	5.4	740			-3000	3000	WS 5 kts, 19,71 good
300	511	118	4214	9/4/07	7:57:27	125	3.1	4.8	146.6	7.9	-38	27	8	5.7	770			-3000	3000	WS 5-6 kts, 19 good, 7-71OD
300	512	118	4214	9/4/07	8:02:23	124	7.8	4.8	142.2	5.0	3	27	8.2	5.9	780			-3000	3000	WS 4-5 kts, 19,71 good
300	513	134	4214	9/4/07	8:07:00	137	6.0	4.3	141.3	5.5	33	27	9.7	6.2	800	2515	21600	-3000	3000	WS 4-6 kts, 19,6-71 OD, 250 IAS
300	514	134	4214	9/4/07	8:11:45	137	3.8	3.2	144.1	4.5	15	27	9.7	6.2	800			-3000	3000	WS 3 kts, 19,71 good
300	515	97	4214	9/4/07	8:16:32	106	11.5	4.6	147.6	5.7	0	26	6.6	5.5	740			-3000	3000	Housekeeping, WS 3-5 kts, 19,71 good
300	516	97	4214	9/4/07	8:21:41	105	5.2	6.8	145.0	3.4	8	27	6.7	5.5	740			-3000	3000	Housekeeping, WS 3-4 kts, 19,71 good
300	517	97	4214	9/4/07	9:25:22	105	2.0	6.1	146.7	2.7	7	30	7.4	5.4	750			-3000	3000	Housekeeping, WS 3-6 kts
300	530	97	4214	9/4/07	10:42:15	101	-0.8	7.4	146.0	4.1	168	31	6.5	5.2	750	3054	22139	-3000	3000	Housekeeping, WS 3-4 kts, 19,71 good
301	531	97	4215	9/5/07	6:46:14	106	3.9	4.6	142.1	2.7	7	27	6.9		730			-3000	3000	Housekeeping, WS 3 kts, 19,71 good
301	548	97	4215	9/5/07	8:30:17	104	2.7	5.7	147.6	4.8	15	28	6.8	<5	730	1707	20792	-3000	3000	Housekeeping, WS 3 kts, 19,71 good
301	549	97	4215	9/5/07	9:40:39	104	12.0	13.6	141.9	4.7	-24	30	7.5		720	4491	23576	-3000	3000	Housekeeping, WS 2 kts, 19,71 good
301	571	97	4215	9/5/07	11:42:24	102	4.5	6.4	149.7	6.0	-7	32	6.8	5.3	740	1796	20881	-3000	3000	Housekeeping WS 3-7kts 19,71 good
302	572	97	4216	9/6/07	6:39:05	101	0.8	5.0	146.4	3.0	1	26	7	5.4	710	4132	23217	-3000	3000	Housekeeping, WS 0-3 kts, 19,71 good
302	573	37	4216	9/6/07	6:45:14	47	1.3	4.8	144.5	3.8	-2	25	6.2	5.1	720	3593	22678	-3000	3000	WS 2-3 kts, 19,71 good
302	574	59	4216	9/6/07	6:52:46	68	8.4	7.1	150.0	2.9	-2	25	6.1	5.1	720	3413	22498	-3000	3000	WS 3 kts, 19,71 good, possibly low
302	575	80	4216	9/6/07	6:58:39	85	0.5	4.5	146.7	2.4	-4	25	6.1	5.1	730	3323	22408	-3000	3000	WS 3 kts, 19,71 good
302	576	107	4216	9/6/07	7:03:36	107	3.3	5.7	146.1	4.8	15	25	7.1	5.4	750	3323	22408	-3000	3000	WS 2-5 kts, 19,71 good, possibly low
302	577	118	4216	9/6/07	7:08:31	121	6.5	6.4	140.4	6.5	24	25	8.1	5.9	780	3233	22318	-3000	3000	WS 3-5 kts, 19 good, 3and6-71 OD
302	578	118	4216	9/6/07	7:13:26	119	-0.5	5.4	148.3	3.9	-9	25	7.9	5.8	780	3144	22229	-3000	3000	WS 4 kts, 19,71 good
302	579	134	4216	9/6/07	7:18:04	133	3.3	3.3	145.9	4.3	3	25	9.7	6.2	810	3144	22229	-3000	3000	WS 4-6 kts, 19,71 good
302	580	97	4216	9/6/07	7:22:58	104	10.6	11.2	147.6	5.7	-9	25	6.7	5.4	720	2874	21959	-3000	3000	Housekeeping, WS 3-5 kts, 19,71 good
302	591	37	4216	9/6/07	7:53:41	40	4.8	6.1	147.9	5.1	-5	25	5.9	5.1	720			-3000	3000	WS 6-10 kts, , 19,71 good
302	592	59	4216	9/6/07	8:00:51	62	2.2	5.2	149.4	4.3	0	26	5.5	5	700	1886	20971	-3000	3000	WS 2-9 kts, 19,71 good
302	593	80	4216	9/6/07	8:06:54	83	3.3	5.6	148.4	6.3	15	26	5.3	5.1	610	1796	20881	-3000	3000	WS 4-9 kts, 19,71 good
302	594	107	4216	9/6/07	8:12:38	106	-2.0	3.5	145.7	4.2	1	26	7.1	5.4	750	1707	20792	-3000	3000	WS 8-12 kts, 19,71 good
302	595	97	4216	9/6/07	8:17:31	97	-0.2	4.9	146.8	6.5	2	26	6.1	5	720	1617	20702	-3000	3000	Housekeeping, WS 5-10 kts, 19,71 good

Table 13. Mi-8M Source Noise Approach Flight Test Points

Flight Code	Run Number	Target KIAS	Target GS, deg	Target ROC, ft/min	Flight #	Test Date	Data On Time	Average Aircraft Speed, kts	Altitude over Center, ft.	Average GS, deg	Average ROC, ft/min	Aircraft OAT, deg C	Collective Angle, deg	EPR	PTIT, deg C	Fuel Rem, lbs	Aircraft GW, lbs	Data Start Range, ft	Data End Range, ft	Comments
300	518	37	3	-196	4214	9/4/07	9:32:59	47	233.5	3.04	-251	28	6.5	<5	690			-8400	2200	WS 5 kts, 1and5-19 OD, 71 good
300	519	37	3	-196	4214	9/4/07	9:40:39	44	259.4	3.1	-238	28	6	<5	700			-8400	2200	WS 3 kts, 19, 5-71 OD
300	520	59	3	-314	4214	9/4/07	9:48:00	63	252.3	2.88	-322	29	5.5	<5	690			-8400	2200	WS 5-8 kts, 19,71 good
300	521	80	3	-433	4214	9/4/07	9:54:05	85	255.5	2.77	-413	28						-8400	2200	WS 5-8 kts, 19,71 good
300	522	97	3	-511	4214	9/4/07	9:59:00	99	255.9	2.82	-493	28	5.3	5	670			-8400	2200	WS 3-8 kts, 19,71 good, jet noise in background
300	523	37	6	-393	4214	9/4/07	10:04:28	43	260.3	6.02	-460	28	5.2	5	690	3772	22857	-9000	1600	WS 3-6 kts, 19 good, 8-71 OD
300	524	59	6	-629	4214	9/4/07	10:11:15	63	281.7	5.8	-645	28	5.1	5	660			-9000	1600	WS 5-10 kts, 19,71 good
300	525	80	6	-866	4214	9/4/07	10:16:50	86	267.8	5.92	-896	28		5				-9000	1600	WS 2-10 kts, 19 good, 10-71 OD
300	526	97	6	-1023	4214	9/4/07	10:21:52	100	268	6.21	-1092	28						-9000	1600	WS 3-9 kts, 19,71 good
300	527	80	9	-1299	4214	9/4/07	10:26:32	87	259.9	9.87	-1509	28	3	<5				-10000	1000	WS 5-10 kts, 19,71 good
300	528	80	9	-1299	4214	9/4/07	10:31:19	84	264.3	9.02	-1334	28	3	<5	600			-10000	1000	WS 5-9 kts, 19,71 good
300	529	59	12	-1259	4214	9/4/07	10:36:50	64	261.5	11.98	-1342	27		<5	600			-10000	400	WS 5-8 kts, 19,71 good
301	532	37	3	-196	4215	9/5/07	6:52:03	52	249.2	3.09	-285	27	5.3	<5				-9000	2200	WS 3 kts, 19,71 good
301	533	59	3	-314	4215	9/5/07	6:59:08	73	253.6	2.97	-383	27	5.2	<5	680			-9000	2200	WS 3 kts, 19,71 good
301	534	80	3	-433	4215	9/5/07	7:05:20	94	245.1	3.15	-519	27						-9000	2400	WS 3 kts, 19,71 good
301	535	97	3	-511	4215	9/5/07	7:11:09	107	257.9	3.11	-587	28	5.7	<5	690			-9000	2400	WS 3 kts, 19,8-9-71 OD
301	536	37	6	-393	4215	9/5/07	7:17:18	50	253.1	5.93	-526	28	4.5	<5	670			-9000	1400	WS 3 kts, 19,71 good
301	537	59	6	-629	4215	9/5/07	7:23:40	72	254.4	6.23	-794	27	4.1	<5	660			-9000	1000	WS 3 kts, 19,71 good
301	538	80	6	-866	4215	9/5/07	7:29:23	89	262	6.15	-965	27	4.5	<5	610			-9000	1000	WS 0-3 kts, 19,71 good
301	539	97	6	-1023	4215	9/5/07	7:34:29	106	275.1	5.86	-1094	27	4.5	<5	660			-9000	1000	WS 0-3 kts, 19,71 good
301	540	37	9	-590	4215	9/5/07	7:39:25	46	257.5	9.2	-740	27	4.8	<5	660			-10000	1000	WS 3 kts, 19,71 good
301	541	59	9	-944	4215	9/5/07	7:45:59	67	254.3	9.06	-1072	27		<5	610			-10000	1000	WS 3 kts, 19,71 good
301	542	80	9	-1299	4215	9/5/07	7:52:33	92	257	9.38	-1506					2156	21241	-10000	1000	WS 3 kts, 19,71 good
301	543	37	12	-787	4215	9/5/07	7:58:05	45	264.9	11.73	-928	27	3.5	<5	620			-8000	1000	WS 2-3 kts, 19,71 good
301	544	59	12	-1259	4215	9/5/07	8:05:04	69	254.8	11.79	-1528	27	2	<5	600			-8000	1000	WS 3 kts, 19,71 good
301	545	37	3	-196	4215	9/5/07	8:11:53	49	243.5	2.94	-253	28	5	<5	710			-10000	2000	WS 3 kts, 19 good,10-71 OD
301	546	59	3	-314	4215	9/5/07	8:19:06	68	238.5	2.93	-349	28	4.7	<5	690			-10000	2200	WS 3 kts, 19,71 good
301	547	80	3	-433	4215	9/5/07	8:24:39	89	252.9	2.89	-457	27	4.7	<5	660	1527	20612	-10000	2000	WS 3 kts, 19,71 good
301	550	97	3	-511	4215	9/5/07	9:46:44	102	246.1	3.12	-561	30	5.8	<5	690	4401	23486	-10000	2200	WS 0 kts, 19,71 good, possible explosion during run
301	551	37	6	-393	4215	9/5/07	9:52:48	46	252.4	5.99	-487	29	5.8	<5	690	4221	23306	-10000	1800	WS 1-2 kts, 19,71 good
301	552	59	6	-629	4215	9/5/07	9:59:42	69	248.6	6.07	-732	30	4.8	<5	670	4132	23217	-10000	1800	WS 0 kts, 19,71 good
301	553	80	6	-866	4215	9/5/07	10:05:06	88	262.2	6.2	-950	30	4.8	<5	650	4132	23217	-10000	1800	WS 0-3 kts, 19,71 good
301	554	97	6	-1023	4215	9/5/07	10:10:24	109	253.8	6.3	-1212	30	4	<5	660	4042	23127	-10000	1600	WS 0-3 kts, 19,71 good
301	555	37	9	-590	4215	9/5/07	10:15:46	47	279.3	9.2	-766	29	5	<5	650	3503	22588	-10000	1000	WS 0 kts, 19,71 good
301	556	59	9	-944	4215	9/5/07	10:23:04	73	283.7	9.33	-1199	29	4.2			3413	22498	-10000	1000	WS 3-4 kts, 19,71 good
301	557	80	9	-1299	4215	9/5/07	10:29:15	94	256.6	9.07	-1503	28	3.5	<5	620	3413	22498	-10000	1000	WS 0 kts, 19,71 good
301	558	37	12	-787	4215	9/5/07	10:34:40	45	273.1	9.49	-912	28	5	<5	670	2964	22049	-8000	800	WS 3-5 kts, 19 good, 71 OD most channels
301	559	59	12	-1259	4215	9/5/07	10:46:23	75	272.8	12.09	-1564	28	3.6	<5	600	2874	21959	-8000	800	WS 1-3 kts, 19,71 good, repeat at pilot request
301	560	59	12	-1259	4215	9/5/07	10:52:01	72	256.7	11.74	-1492	28	3	<5	600	2784	21869	-8000	800	WS 3 kts, 19 good, 6-71 OD
301	561	37	12	-787	4215	9/5/07	10:58:32	43	279.8	11.65	-881	28		<5	650	2515	21600	-8000	800	WS 0-3 kts, 19,71 good

Table 14. Mi-8M Source Noise Departure Flight Test Points

Flight Code	Run Number	Target KIAS	Target ROC, ft/min	Flight #	Test Date	Data On Time	Average Aircraft Speed, kts	Altitude over Center, ft.	Average ROC, ft/min	Aircraft OAT, deg C	Collective Angle, deg	EPR	PTIT, deg C	Fuel Rem, lbs	Aircraft GW, lbs	Data Start Range, ft	Data End Range, ft	Comments
301	562	21	492	4215	9/5/07	11:05:44	31	241.1	592	30	8.5	6.2	830	2156	21241	-1000	2800	3-4kts,19 good, 71 good
301	563	37	492	4215	9/5/07	11:12:20	44	248.3	606	30	8.5	5.4	800	2156	21241	-1000	4000	2-3kts, 19 good, 71 good
301	564	37	492	4215	9/5/07	11:16:35	49	248.3	661	30	8.5	5.7	800	2156	21241	-1000	4000	3-5kts, 19 good, 71 good
301	565	59	492	4215	9/5/07	11:20:32	63	233.9	14	31	7.2	5.4	780	2156	21241	-1000	5000	0-2kts, 19 good, 71 good
301	566	59	492	4215	9/5/07	11:23:50	66	237.4	623	32	7.2	5.4	730	1976	21061	-1000	4800	3-10kts, 19 good, 71 good
301	567	80	492	4215	9/5/07	11:27:27	84	251	464	32	7.4	5.9	790	1976	21061	-1000	5000	3-10kts, 19 good, 71 good
301	568	80	492	4215	9/5/07	11:30:44	83	223.3	584	32	7	5.5	690	1976	21061	-1000	4800	4-6kts, 19,71 good
301	569	97	492	4215	9/5/07	11:34:04	98	184.8	573	32	7.2	5.5	780	1976	21061	-1000	7000	2-4kts, 19,71 good
301	570	97	492	4215	9/5/07	11:37:44	100	203.8	740	32	8.5	5.5	800	1796	20881	-1000	5800	4-6kts, 19,71 good

Table 15. Mi-8M Source Noise Hover Test Points

Flight Code	Run Number	Target Heading, deg	Flight Number	Test Date	Data On Time	Average Y, ft	Std. Dev. Y, ft	Average Altitude, ft	Std. Dev., Altitude, ft	Average Heading, deg	Aircraft OAT, deg C	Collective Angle, deg	EPR	PTIT, deg C	Fuel Rem, lbs	Aircraft GW, lbs	Comments
302	581	180	4216	9/6/07	7:34:29	9.5	11.4	142.1	8.9	179.9							3 kts, 19,71 good, 400 ft offset
302	582	225	4216	9/6/07	7:35:48	9.5	11.4	142.1	8.9	228.6	25	8.5	6	800	2156	21241	4 kts, 19,71 good, 400 ft offset
302	583	270	4216	9/6/07	7:37:21	41.8	10.3	161.2	4.4	277.6	25	8.5	6	800	2156	21241	3 kts, 19,71 good, 400 ft offset
302	584	315	4216	9/6/07	7:38:54	-17.7	3.8	153.6	3.7	322.7	25	8.2	6	815	2156	21241	4-5 kts, 19,71 good, 400 ft offset
302	585	0	4216	9/6/07	7:40:44	-32.9	41.8	143.8	4.7	4.9		8.4	6	805	2156	21241	4-5 kts, 19,71 good, 400 ft offset
302	586	45	4216	9/6/07	7:42:35	-39.3	5.4	146.6	7.5	49.6		8.2	6	805	1976	21061	6-8 kts, 19,71 good, 400 ft offset
302	587	90	4216	9/6/07	7:44:13	-36.2	2.8	142.6	3.3	92.4					1886	20971	3-4 kts, 19,71 good, 400 ft offset
302	588	135	4216	9/6/07	7:45:46	-15.0	8.1	149.4	4.6	137.1		8.2	6	810	1886	20971	3-4 kts, 19,71 good, 400 ft offset
302	589	180	4216	9/6/07	7:47:18	4.1	6.1	147.3	6.3	178.8	25	8.2	6	800	1886	20971	3 kts, 19,71 good, 400 ft offset
302	590	45	4216	9/6/07	7:48:31	-6.1	14.1	147.8	2.9	49.5	25	8.1	6	800	1796	20881	4-8 kts, 19,71 good, 400 ft offset

Table 16. Ambient NoiseTest Points

Flight Code	Run Number	Test Date	Data On Time	Comments
100	901	8/20/07	6:57:10	Ambient
100	902	8/20/07	10:27:50	Ambient
101	901	8/21/07	6:34:42	Ambient – all ACs on, mic 1 dropped off line
101	902	8/21/07	8:09:45	Ambient – all ACs on
101	903	8/21/07	8:11:30	Ambient
	901	8/23/07	6:29:41	Ambient 19, 71 good, WS 2 kts
102	902	8/23/07	8:10:07	Ambient 19,71 good, WS 4 kts
102	903	8/23/07	8:40:17	Ambient 19,71 good WS 5 kts
103	901	8/24/07	6:32:55	Ambient, aircraft noise may be present at 45k
103	902	8/24/07	8:04:08	Ambient, ch 4 drop offline, possible ac
103	903	8/24/07	9:19:02	Ambient, WS 4 kts, mic 8 bad
300	901	9/4/07	6:33:45	Ambient
300	902	9/4/07	8:35:43	Ambient
300	903	9/4/07	10:58:35	Ambient
301	901	9/5/07	6:25:56	Ambient
301	902	9/5/07	8:43:40	Ambient 0-2 kts
301	903	9/5/07	11:54:59	Ambient 45 sec 0kts, 4-6kts the rest
302	901	9/6/07	6:23:19	Ambient
302	902	9/6/07	8:31:08	Ambient
500	901	8/19/07		Ambient
501	901	9/8/07	6:07:22	Ambient
501	902	9/8/07	6:09:06	Ambient - faiint jet noise in background
502	901	9/9/07	6:14:53	Ambient

Table 17. Run log heading descriptions

Column Heading	Description	Accuracy
Aircraft GW, lbs	Aircraft gross weight estimated from AC takeoff gross weight and fuel remaining.	+/- 50 lbs – MD-902 +/- 200 lbs – Mi-8M
Aircraft OAT, deg C	Outside air temperature as measured at aircraft (Note 2)	+/- 1 deg C
Altitude over Center, ft	Altitude of aircraft as it passes over the center microphone (Note 1)	+/- 0.2 ft
Average Aircraft Speed, kts	Average aircraft ground speed (Note 1)	+/- 1 kt
Average Altitude, ft	Average aircraft altitude over center microphone (Note 1)	+/- 0.2 ft
Average Bank Angle, deg	Average aircraft bank angle from onboard instrumentation package	+/- 0.1
Average GS, deg	Average glide slope angle (Note 1)	+/- ? deg
Average Heading, deg	Average aircraft magnetic heading from onboard instrumentation package	+/- 0.1 deg
Average ROC, ft/min	Average rate of climb (Note 1)	+/- 12 ft/min
Average Y, ft	Average Lateral position of aircraft (Note 1)	+/- 0.2 ft
Collective Angle, deg	Collective pitch angle (Note 2)	+/- 0.2 deg
Comments	Comments from control van and flight engineer, wind speed (WS) indicated is measured at the control trailer	
Data On Time	Eastern Standard Time data acquisition started in Hours Minutes Seconds read from control room clock.	Within 1 second of actual start time recorded in data file
Data End Range, ft	Distance along flight track after center microphone used to end data analysis.	
Data Start Range, ft	Distance along flight track before center microphone used to start data analysis.	

Table 17. Run log heading descriptions (concluded)

Column Heading	Description	Accuracy
EPR	Engine pressure ratio (Note 2)	+/- 3%
Flight Code	Unique number assigned to each flight of the aircraft or test setup. Used to create unique file description.	
Flight Number	Flight number assigned by range control	
Fuel Remaining, lbs	The fuel remaining at time of test point (Note 2)	+/- 20 lbs – MD-902 +/- 100 lbs – Mi-8M
PTIT, mm HG	Power turbine inlet temperature	+/- 12 deg C
Q	Engine torque in percent (Note 2)	+/- 2 %
Run Number	Unique run number for each data point acquired	
Std. Dev. Altitude, ft	Standard deviation of altitude over center microphone from the average (Note 1)	+/- 0.2 ft
Std. Dev. Y, ft	Standard deviation of lateral position from the average (Note 1)	+/- 0.2 ft
Target Bank Angle, deg	Target aircraft bank angle	Desired is +/- 2 deg
Target GS, deg.	Target glide slope angle	Desired is +/- 0.5 deg
Target Heading, deg	Target aircraft magnetic heading in degrees	Desired is +/- 0.1 deg
Target KIAS	Desired indicated airspeed in knots	Desired is +/- 2 knots
Target ROC, ft/min	Target ROC based on desired glide slope and KIAS	
Test Date	Date data acquired	

Note 1. Value derived from aircraft GPS data during the time that data is analyzed
Note 2. Read by flight test engineer from aircraft instrumentation during data run

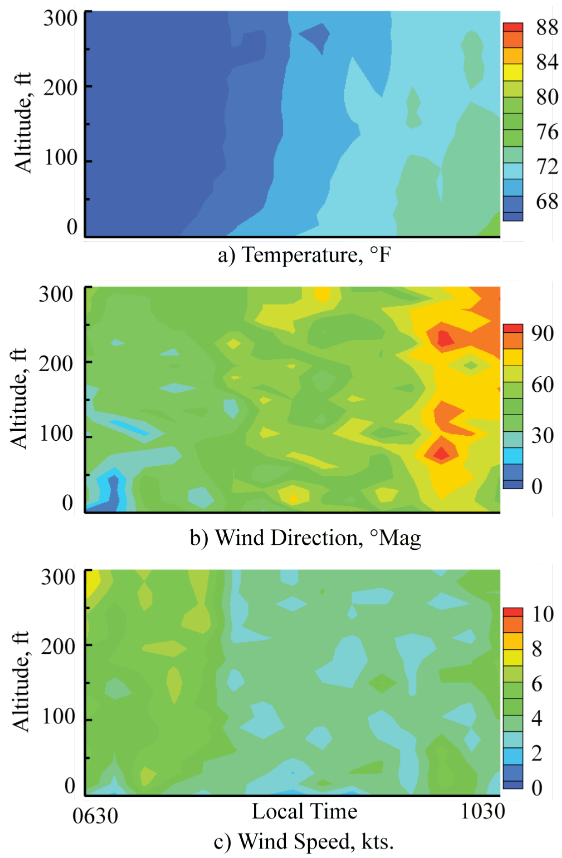

Figure 13. Typical weather during testing

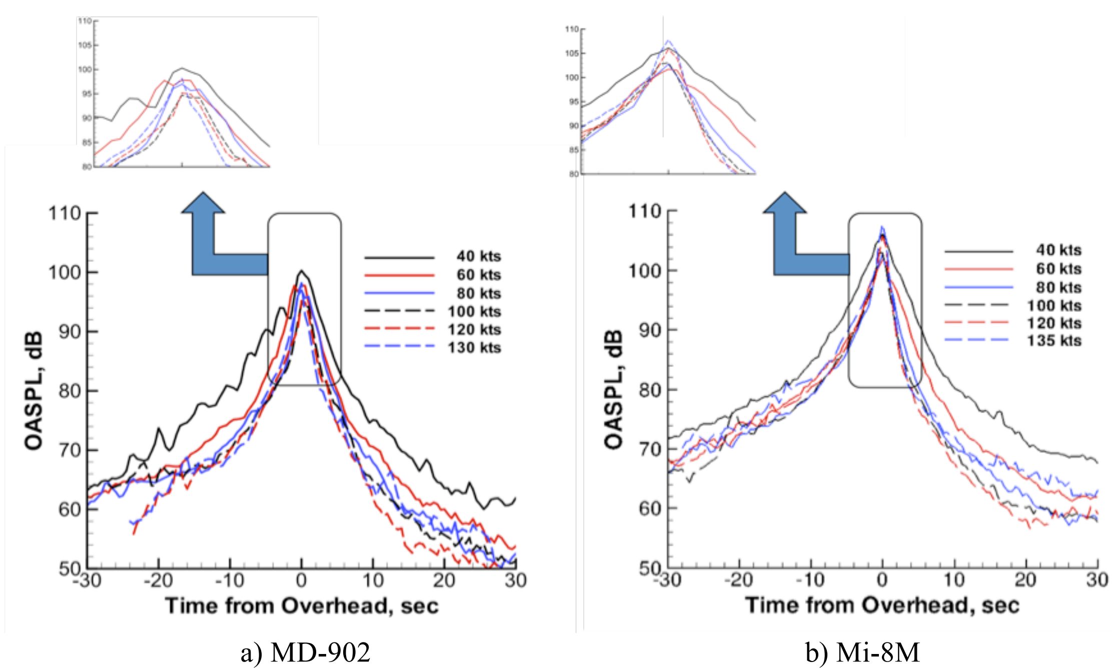

Figure 14. Speed Sweep for MD-902 and Mi-8M, level flight, 150 ft AGL.

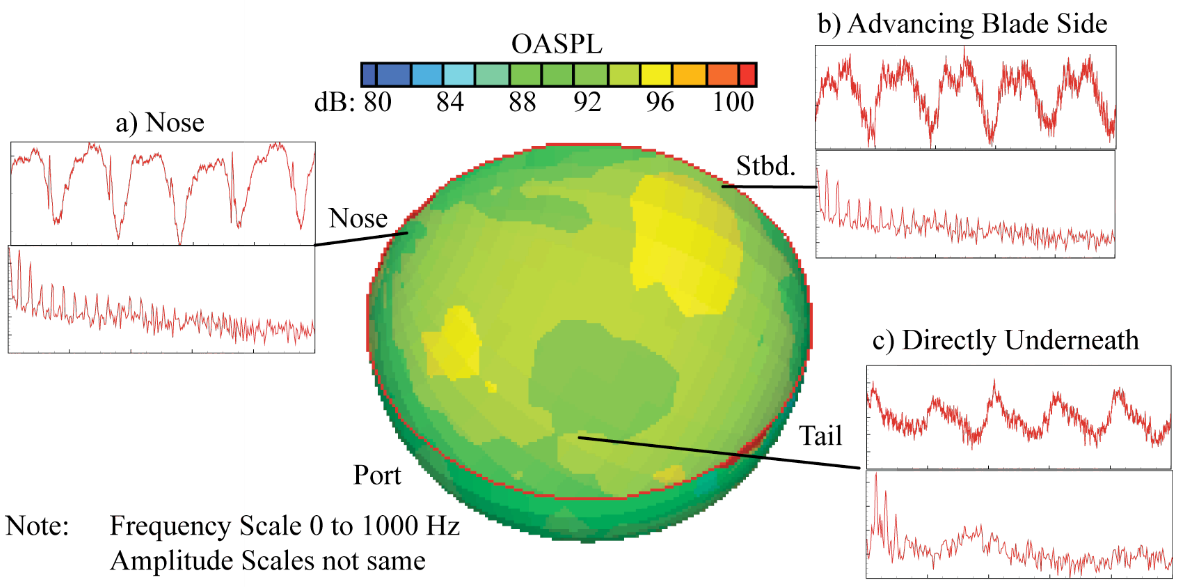

Figure 15. OASPL semi-sphere with sample time history and spectra data for MD-902, 60 kts level flight

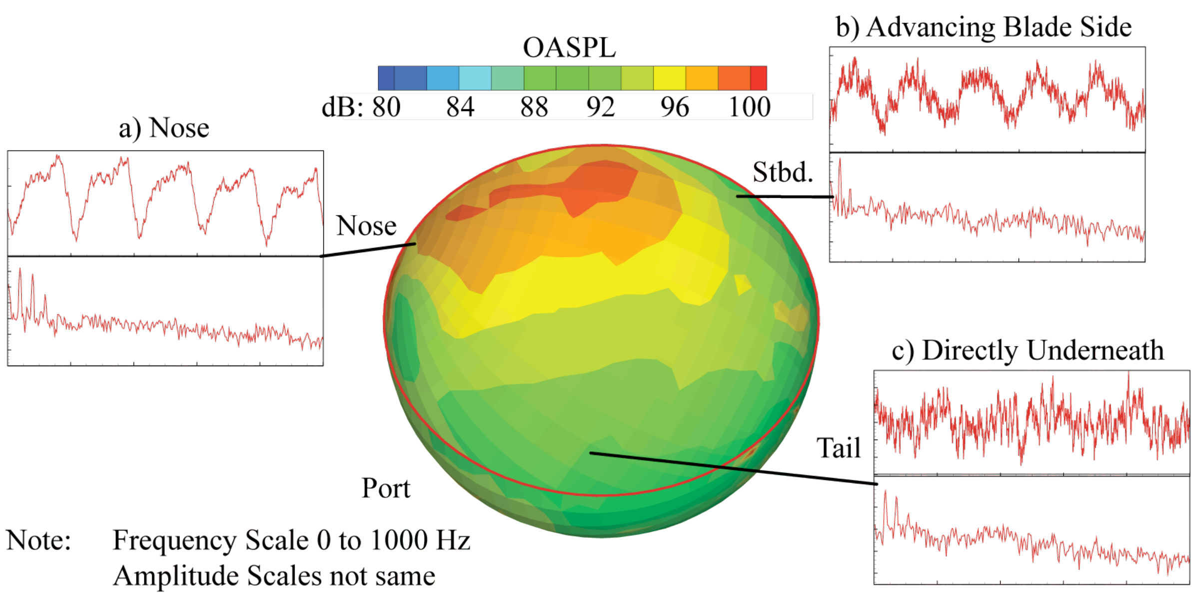

Figure 16. OASPL semi-sphere with sample time history and spectra data for MD-902, 120 kts level flight

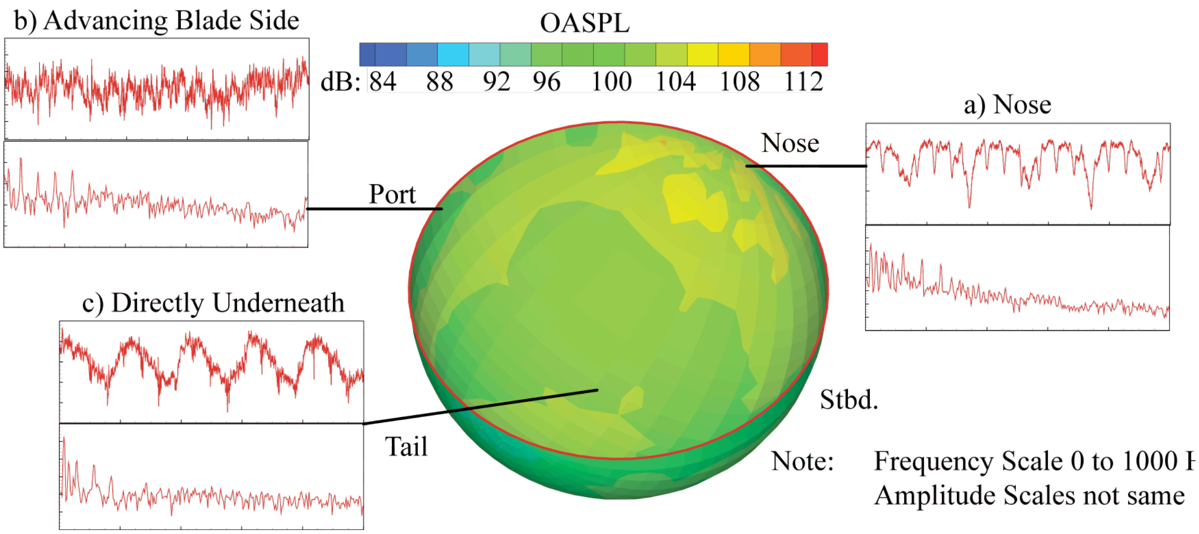

Figure 17. OASPL semi-sphere with sample time history and spectra data for Mi-8M, 60 kts level flight

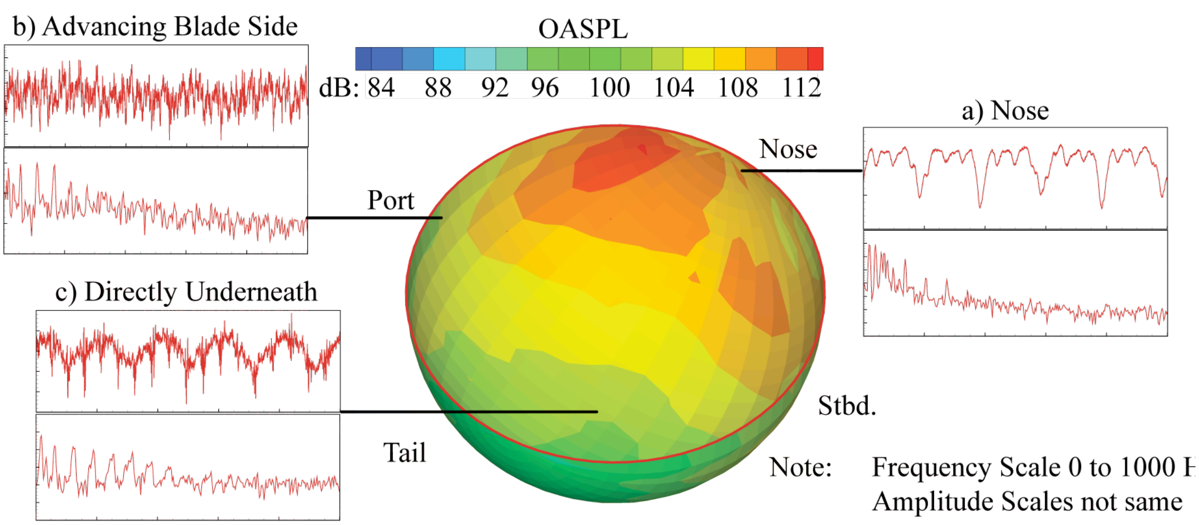

Figure 18. OASPL semi-sphere with sample time history and spectra data for Mi-8M, 120 kts level flight

Figure 19. Propane cannon, resonator and weather baloon used in propagation test.

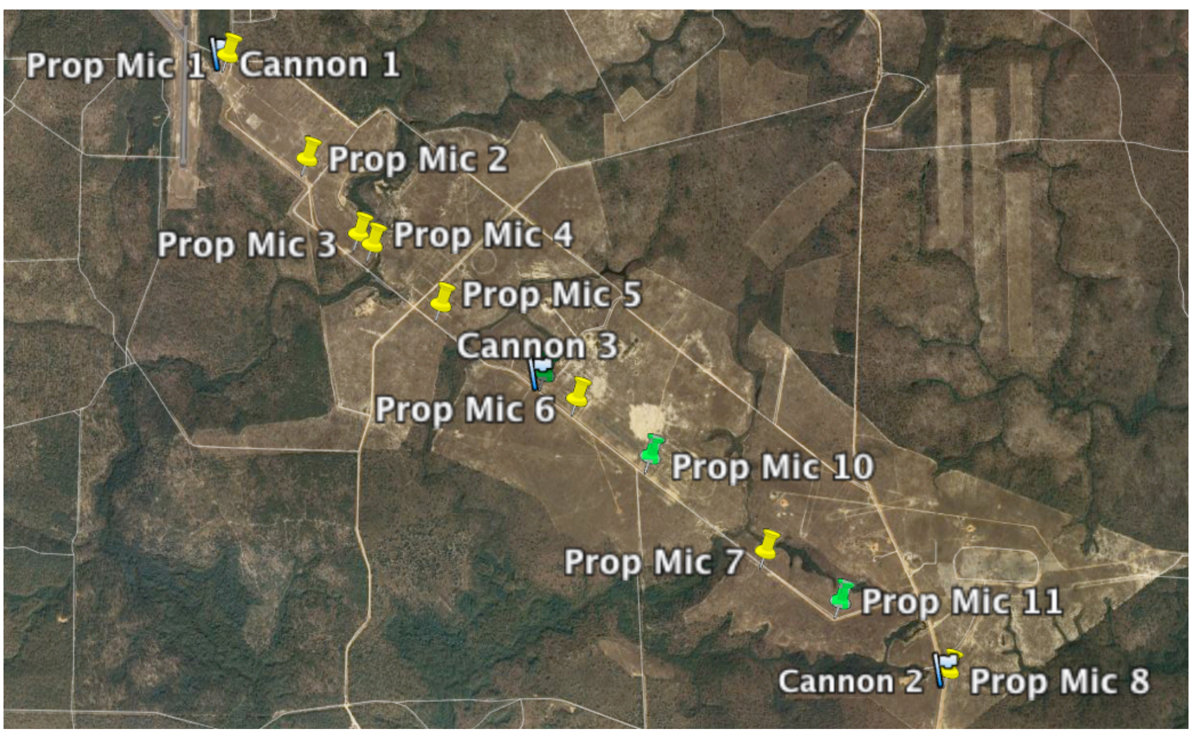

Figure 20. Propagation test layout

Table 18. Locations of long range propagation testing hardware.

Position	Latitude Longitude	Grnd. Elev. (ft)	Dist. From Cannon 1 (ft)
Cannon 1	30.66348459 N 86.34640101 W	228.06	0
Cannon 2	30.61655557 N 86.28244655 W	215.63	26,413
Cannon 3	30.6391518 N 86.31826321 W	182.66	12,535
Prop Mic 1	30.66340362 N 86.34634622 W	227.63	34
Prop Mic 2	30.65558258 N 86.33937571 W	185.11	3,633
Prop Mic 3	30.64983875 N 86.33484701 W	167.46	6,166
Prop Mic 4	30.64904562 N 86.33358923 W	117.64	6,634
Prop Mic 5	30.64449839 N 86.32753472 W	181.15	9,122
Prop Mic 6	30.63730344 N 86.31548384 W	186.49	13,631
Prop Mic 7	30.62566946 N 86.29794884 W	194.76	20,555
Prop Mic 8	30.61658058 N 86.28261597 W	215.29	26,366
Prop Mic 9	30.63920091 N 86.31836167 W	182.81	12,501
Prop Mic 10	30.63292637 N 86.30899577 W	196.62	16,208
Prop Mic 11	30.62188841 N 86.29218863 W	188.37	22,825

Table 19. Propagation test run log.

Flight Code	Run Number	Noise Source	Date	Data On Time	Comments
700	1	Propane Cannon 1	8/17/07	6:40:12	some kind of engine to NW? heard near mic 5
700	2	Propane Cannon 2	8/17/07	6:26:01	continous engine nose to the north
700	3	Resonator	8/17/07	6:50:40	continous engine nose to the north
700	4	Propane Cannon 1	8/17/07	7:10:04	"
700	5	Propane Cannon 2	8/17/07	7:13:10	"
700	6	Resonator	8/17/07	7:16:15	"
700	7	Propane Cannon 1	8/17/07	7:35:36	"
700	8	Propane Cannon 2	8/17/07	7:39:00	" aborted at beginning then restarted
700	9	Resonator	8/17/07	7:44:10	SUV drove by mic 8 during middle of run - overdrove mic 8
700	10	Propane Cannon 1	8/17/07	8:02:35	
700	11	Propane Cannon 2	8/17/07	8:05:35	
700	12	Resonator	8/17/07	8:09:30	
700	13	Propane Cannon 1	8/17/07	8:36:06	mic 4 out
700	14	Propane Cannon 2	8/17/07	8:38:54	mic 4 out
700	15	Resonator	8/17/07	8:41:52	mic 4 out
700	16	Ambient	8/17/07	9:08:40	
700	17	Propane Cannon 1	8/17/07	9:09:48	many mil jets beginning about mid run
700	18	Propane Cannon 1	8/17/07	9:17:13	
700	19	Propane Cannon 2	8/17/07	9:20:20	
700	20	Resonator	8/17/07	9:23:32	
700	21	Ambient	8/17/07	9:44:33	
700	22	Propane Cannon 1	8/17/07	9:45:55	
700	23	Propane Cannon 2	8/17/07	9:48:46	
700	24	Resonator	8/17/07	9:51:30	
700	25	Ambient	8/17/07	10:15:10	
700	26	Propane Cannon 1	8/17/07	10:16:25	
700	27	Propane Cannon 2	8/17/07	10:19:15	
700	28	Resonator	8/17/07	10:22:15	
700	29	Ambient	8/17/07	10:44:00	
700	30	Propane Cannon 1	8/17/07	10:45:25	
700	31	Propane Cannon 2	8/17/07	10:48:02	
700	32	Resonator	8/17/07	10:50:38	
700	33	Ambient	8/17/07	11:16:50	
700	34	Propane Cannon 1	8/17/07	11:18:08	
700	35	Propane Cannon 2	8/17/07	11:21:22	
700	36	Resonator	8/17/07	11:24:05	
701	37	Ambient	8/25/07	6:02:55	
701	38	Propane Cannon 1	8/25/07	6:06:28	Mic 5 and 9 have overdrives
701	39	Propane Cannon 2	8/25/07	6:09:54	Mics 7 & 8 unusable
701	40	Propane Cannon 3	8/25/07	6:14:55	numerous mics overdrove reflections at compound
701	41	Resonator	8/25/07	6:18:43	
701	42	Propane Cannon 1	8/25/07	6:22:27	
701	43	Propane Cannon 2	8/25/07	6:25:31	Mic 8 OD
701	44	Propane Cannon 2	8/25/07	6:29:49	
701	45	Propane Cannon 3	8/25/07	6:33:22	Mic 9 OD
701	46	Propane Cannon 3	8/25/07	6:40:14	Mic 4 OD, much higher levels than during run 45
701	47	Ambient	8/25/07	7:01:06	
701	48	Propane Cannon 1	8/25/07	7:04:01	

Table 19. Propagation test run log (concluded)

Flight Code	Run Number	Noise Source	Date	Data On Time	Comments
701	49	Propane Cannon 2	8/25/07	7:06:50	
701	50	Propane Cannon 3	8/25/07	7:10:09	
701	51	Resonator	8/25/07	7:13:23	
701	52	Ambient	8/25/07	7:37:52	impulsive noise in distance (jack hammer or pile driver maybe?)
701	53	Propane Cannon 1	8/25/07	7:41:28	AC to west during run; 6, 8, &10 OD
701	54	Propane Cannon 1	8/25/07	7:45:09	1 OD on 6
701	55	Propane Cannon 2	8/25/07	7:50:04	couple of ODs on 10
701	56	Propane Cannon 3	8/25/07	7:53:33	1 OD on 8
701	57	Resonator	8/25/07	7:56:51	
701	58	Ambient	8/25/07	8:34:57	AC early in run
701	59	Propane Cannon 1	8/25/07	8:39:02	
701	60	Propane Cannon 2	8/25/07	8:42:17	
701	61	Propane Cannon 3	8/25/07	8:45:36	
701	62	Resonator	8/25/07	8:48:33	
701	63	Ambient	8/25/07	9:12:41	
701	64	Propane Cannon 1	8/25/07	9:15:47	
701	65	Propane Cannon 2	8/25/07	9:18:40	
701	66	Propane Cannon 3	8/25/07	9:21:40	
701	67	Resonator	8/25/07	9:24:35	
701	68	Ambient	8/25/07	9:51:19	
701	69	Propane Cannon 1	8/25/07	9:54:26	
701	70	Propane Cannon 2	8/25/07	9:57:17	
701	71	Propane Cannon 3	8/25/07	10:00:20	
701	72	Resonator	8/25/07	10:03:04	
701	73	Ambient	8/25/07	10:21:03	SUV driving near mic 1
701	74	Propane Cannon 1	8/25/07	10:24:29	
701	75	Propane Cannon 2	8/25/07	10:27:13	
701	76	Propane Cannon 3	8/25/07	10:30:03	
701	77	Resonator	8/25/07	10:32:45	
701	78	Ambient	8/25/07	10:51:00	
701	79	Propane Cannon 1	8/25/07	10:53:55	
701	80	Propane Cannon 2	8/25/07	10:56:37	jet noise near end of run
701	81	Propane Cannon 3	8/25/07	11:00:21	
701	82	Resonator	8/25/07	11:03:14	

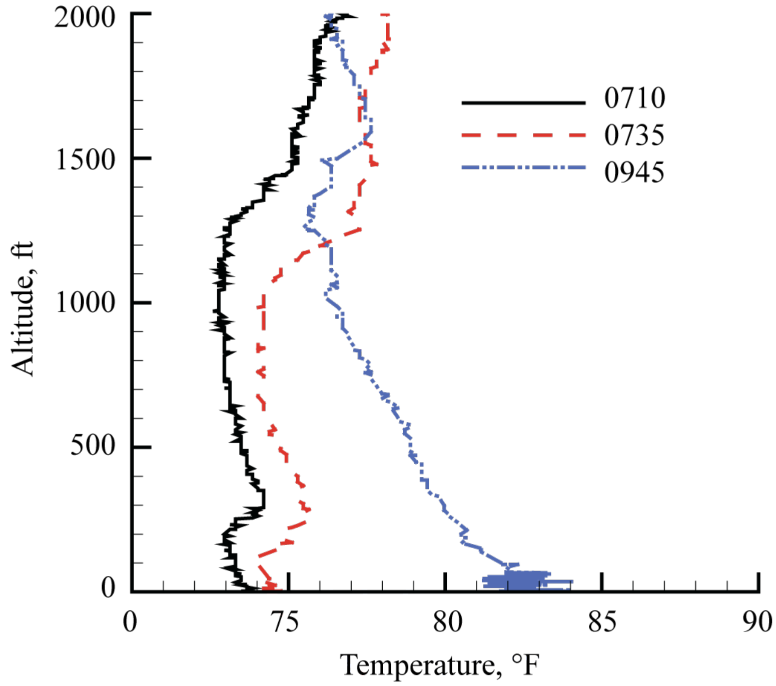

Figure 21. Temperature profiles for three times of day during propagation testing.

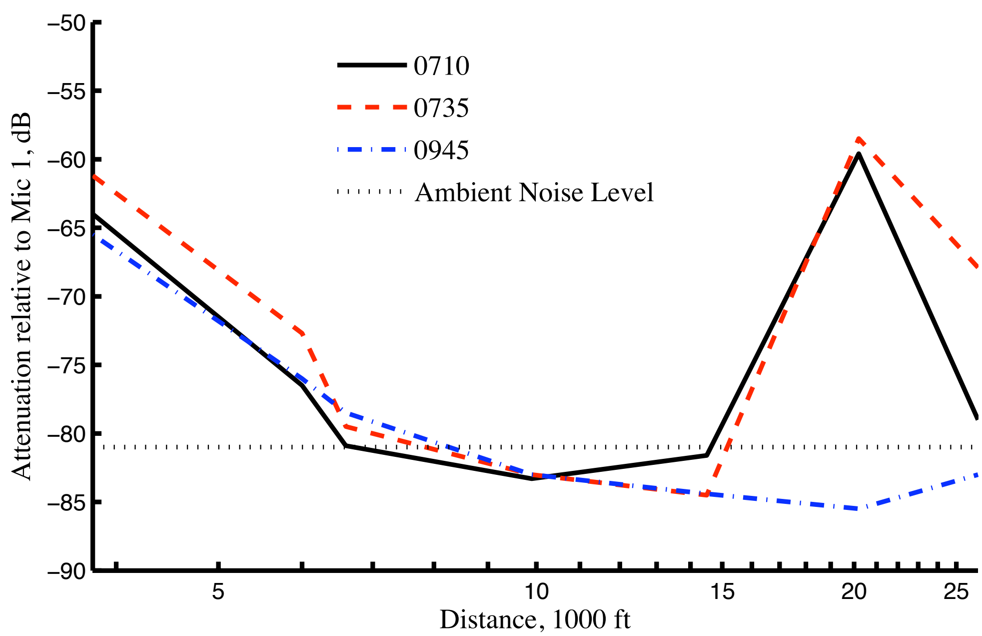

Figure 22. Attenuation relative to microphone 1 for signal generated by cannon 1.

Figure 23. Sound Jury.

Figure 24. Perception test flight tracks. (Map shows 23 miles wide by 18 miles tall)

Table 20. MD-902 Perception test run log.

Flight Code	Run Number	Target KIAS	Flight Number	Test Date	Data On Time	Average Aircraft Speed, kts	Average Altitude, ft	Std. Dev., Altitude, ft	Aircraft OAT, deg C	Q	Fuel Rem, lbs	Aircraft GW, lbs	Comments
500	101	80	2988	8/19/08	7:12:00	81	328.2	53.6	23	52	765	6028	Segment 1 to 2, Set 1 – start time approx. – NASA data bad – AC noise significant
500	102	80	2988	8/19/08	7:27:58	73	310.6	18.2	23	52	664	5927	Segment 3 to 4, AC Noise
500	103	80	2988	8/19/08	7:45:48	86	302.0	17.2	23	50	537	5800	Segment 5 to 6, 3 of 4 ACs off
500	104	80	2988	8/19/08	8:05:15	83	302.8	15.8	24	48	422	5685	Segment 7 to 8, 3 of 4 ACs off
500	105	120	2988	8/19/08	9:36:05	118	292.0	33.7	28	81	873	6136	Segment 1 to 2, Set 1 – start time approx. – NASA data bad – AC noise significant
500	106	120	2988	8/19/08	9:48:40	113	296.8	19.0	29	75	780	6043	Segment 3 to 4, Light AC to north late in run, at ~40% response level after OH, likely caused positives that were not due to 902
500	107	120	2988	8/19/08	10:01:58	121	309.9	15.1	30	75	670	5933	Segment 5 to 6, Winds have picked up, certainly impacting detection range
500	108	120	2988	8/19/08	10:13:04	125	316.3	13.3	30	80	566	5829	Segment 7 to 8
500	109	80	2988	8/19/08	10:21:45	82	326.4	28.7	29	46	492	5755	Segment 1 to 2, Set 2 – air quality is getting poor due to thermals, lots of bumps likely causing excess noise

Table 21. Mi-8M Perception test run log.

Flight Code	Run Number	Target KIAS	Flight Number	Test Date	Data On Time	Average Aircraft Speed, kts	Average Altitude, ft	Std. Dev., Altitude, ft	Aircraft OAT, deg C	Collective Angle, deg	EPR	PTIT, deg C	Fuel Rem, lbs	Aircraft GW, lbs	Comments
501	701	80	4218	9/8/07	6:52:40	89	277.9	24.1	23	6.1	5	710	3717	22802	Set 1 – winds 2-4 kts @ 045 deg. Noise to NE.
501	702	80	4218	9/8/07	7:11:00	71	308.1	32.1	23	6.1	5	710	3186	22271	Winds 2-6 kts @ 045 – 060 deg. Could see before hear.
501	703	80	4218	9/8/07	7:28:26	93	302.3	14.3	23	6.1	5	710	2832	21917	Winds 0-5 kts @ 060 deg. Faint jet noise to W.
501	704	80	4218	9/8/07	7:45:42	82	303.9	20.4	25	6.1	5.7	780	2655	21740	Winds 2-6 kts @ 075 deg. Heard test vehicle just after data on call.
501	705	118	4218	9/8/07	8:00:52	122	304.2	19.0	25	8.3	5.7	780	2389	21474	Winds 2-6 kts @ 45 – 90 deg. Winds picking up. Heard test vehicle just after data on call.
501	706	118	4218	9/8/07	8:15:03	113	305.1	12.2	26	8.1	5.7	780	2389	21474	Winds 1-6 kts @ 045 – 100 deg. Jet noise to NE at beginning of run but faded prior to Mike hearing vehicle. Could see before hear.
501	707	118	4218	9/8/07	8:27:29	126	302.2	7.3	26	8.1	5.7	780	2212	21297	Winds 2-6 kts @ 60 – 90 degº
501	708	118	4218	9/8/07	8:39:03	119	301.9	10.6	27	8	5.7	780	2124	21209	After overhead, could still see AC well after could no longer hear.
502	710	80		9/9/07	6:45:59	85	294.4	12.3	25	6	5	715	2832	21917	Ground winds 6 kts or less @ 15º – 45º, heard AC till just before data off.
502	711	80		9/9/07	7:00:54	73	303.1	12.8	26	6	5	715	2478	21563	“, slight jet noise to west at start of run but died before MW could hear AC., Noise faded on outbound then got louder.
502	712	80		9/9/07	7:19:38	92	307.0	13.2	24	5.9	5	715	2478	21563	“, faded in and out on outbound leg.
502	713	80		9/9/07	7:38:58	82	295.7	13.9	26	5.9	5	715	2389	21474	“, could hear MI-8 prior to data on
502	714	118		9/9/07	7:51:32	125	307.3	30.5	25	7.9	5.8	780	2832	21917	“,faded in and out on outbound.
502	715	118		9/9/07	8:05:09	112	303.6	13.4	26	7.9	5.8	780	2743	21828	Ground winds up to 8 kts @ 0º - 45º
502	716	118		9/9/07	8:17:51	126	304.8	12.8	25	7.9	5.8	780	2566	21651	“, could still hear at data off
502	717	118		9/9/07	8:31:43	116	300.5	23.1	26	7.5	5.8	780	2478	21563	2-6 kts @ 50º, could hear at data on

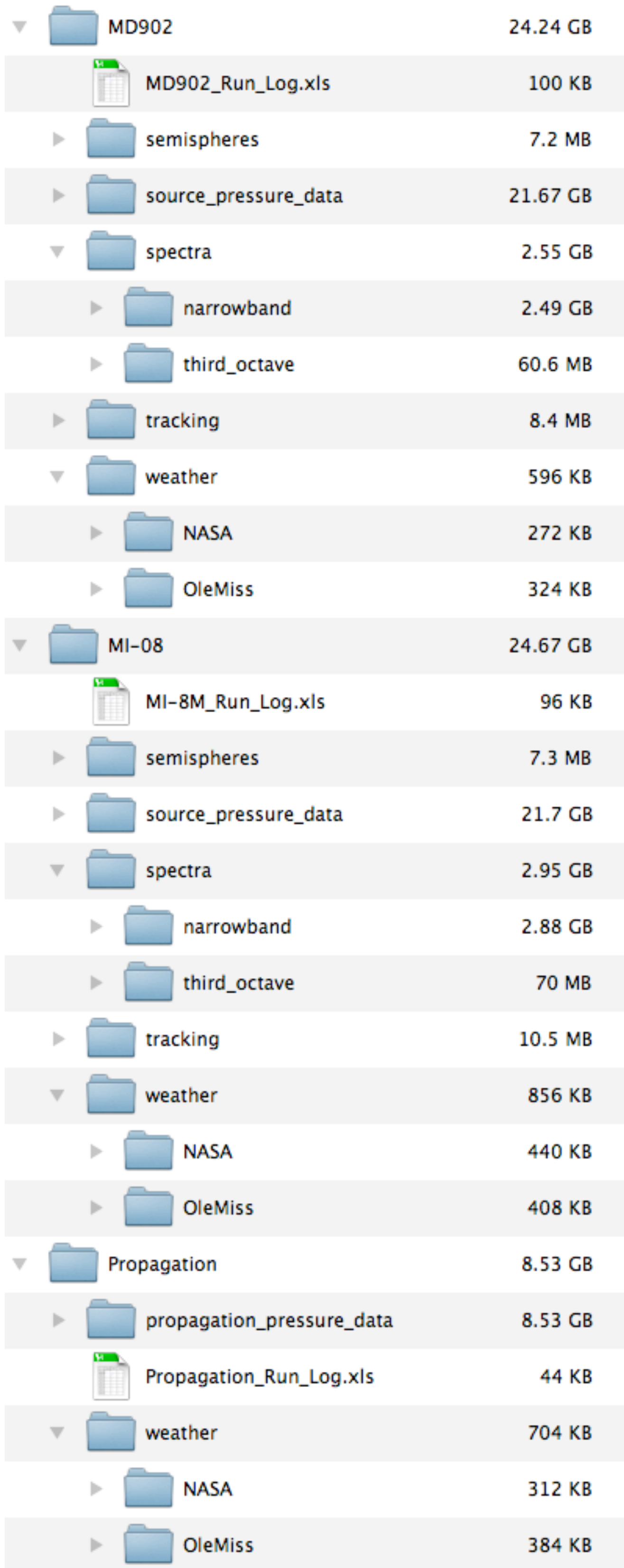

Figure 25. File structure

```
nc= netcdf('/Volumes/LaCie/Eglin III Data/MD902/source_pressure_data/100202_08_pascal.nc',
'noclobber');
if isempty(nc), return, end

%% Global attributes:

nc.test = ncchar("Acoustics Week 3 Flight Test                    ");
nc.location = ncchar("Eglin AFB, Fla                   ");
nc.date = ncchar("August/Sept 2007    ");
nc.run_number = ncchar("100202    ");
nc.noise_source = ncchar("MD902");
nc.mic_number = nclong(1);
nc.X = ncdouble(0.0599999986588955);
nc.Y = ncdouble(109.519996643066);
nc.Z = ncdouble(1.47000002861023);
nc.sample_rate = ncdouble(25000);
nc.start_time = ncdouble(26147.2088);
nc.overhead_time = ncdouble(26178.990234375);
nc.number_samples = nclong(1742297);

%% Dimensions:

nc('nmics') = 1;
nc('icount') = 1742297; %% (record dimension)

%% Variables and attributes:

nc{'pressure'} = ncfloat('icount', 'nmics'); %% 1742297 elements.
nc{'pressure'}.long_name = ncchar("Acoustic Pressure");
nc{'pressure'}.units = ncchar("Pascal");

nc{'X'} = ncfloat('nmics'); %% 1 element.
nc{'X'}.long_name = ncchar("Mic X location (relative to center mic)");
nc{'X'}.units = ncchar("feet");

nc{'Y'} = ncfloat('nmics'); %% 1 element.
nc{'Y'}.long_name = ncchar("Mic Y location (relative to center mic)");
nc{'Y'}.units = ncchar("feet");

nc{'Z'} = ncfloat('nmics'); %% 1 element.
nc{'Z'}.long_name = ncchar("Mic Z location (relative to center mic)");
nc{'Z'}.units = ncchar("feet");

nc{'overhead_time'} = ncfloat('nmics'); %% 1 element.
nc{'overhead_time'}.long_name = ncchar("Overhead time at center mic");
nc{'overhead_time'}.units = ncchar("seconds");
```

Figure 26. NetCDF file content for source_pressure_data files

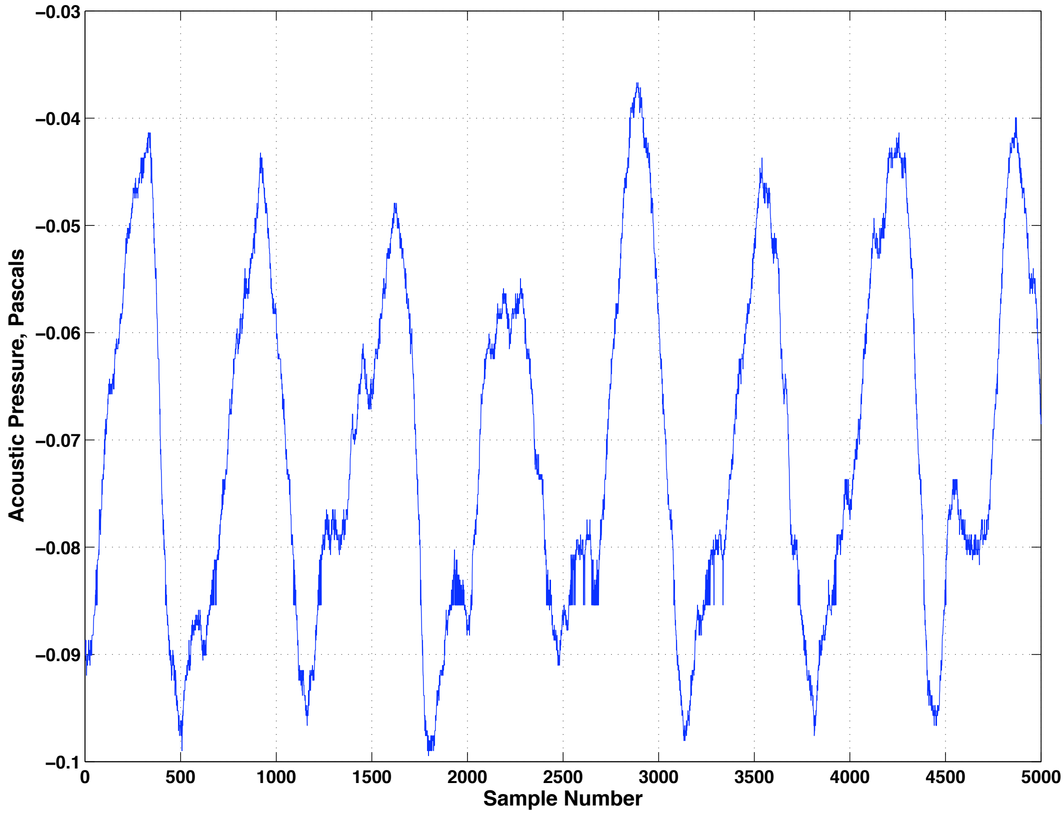

Figure 27. First 5000 acoustic pressure points from file 100202_08_pascal.nc.

```
nc = netcdf('/Volumes/LaCie/Eglin III Data/MD902/spectra/narrowband/100202_08_nbd3.nc',
'noclobber');
if isempty(nc), return, end

%% Global attributes:

nc.test = ncchar("Eglin AFB Acoustic Flight Test                    ");
nc.location = ncchar("Eglin Air Force Base, Fla            ");
nc.date = ncchar("Aug/Sept 2007      ");
nc.run_number = ncchar("100202    ");
nc.time_reference = ncchar("UTC");
nc.digit_rate = ncdouble(25000);
nc.window_func = ncchar("Hamming    ");
nc.np_fft = nclong(8192);
nc.nmics = nclong(1);
nc.cutoff_freq = ncdouble(12500);
nc.num_ave = nclong(2);
nc.overlap = ncfloat(0.5);
nc.nspectra = nclong(139);
nc.start_time = ncdouble(26147.2088);
nc.mic_id = nclong(1);

%% Dimensions:

nc('nmics') = 1;
nc('nfreq') = 4096;
nc('ntime') = 139; %% (record dimension)

%% Variables and attributes:

nc{'freq'} = ncfloat('nfreq'); %% 4096 elements.
nc{'freq'}.long_name = ncchar("narrowband frequency");
nc{'freq'}.units = ncchar("Hz");

nc{'time'} = ncfloat('ntime'); %% 139 elements.
nc{'time'}.long_name = ncchar("time");
nc{'time'}.units = ncchar("seconds");

nc{'ispl'} = ncshort('ntime', 'nfreq', 'nmics'); %% 569344 elements.
nc{'ispl'}.long_name = ncchar("narrowband sound pressure level");
nc{'ispl'}.units = ncchar("dB x 100");
```

Figure 28. NetCDF file content for ART narrow band spectra file.

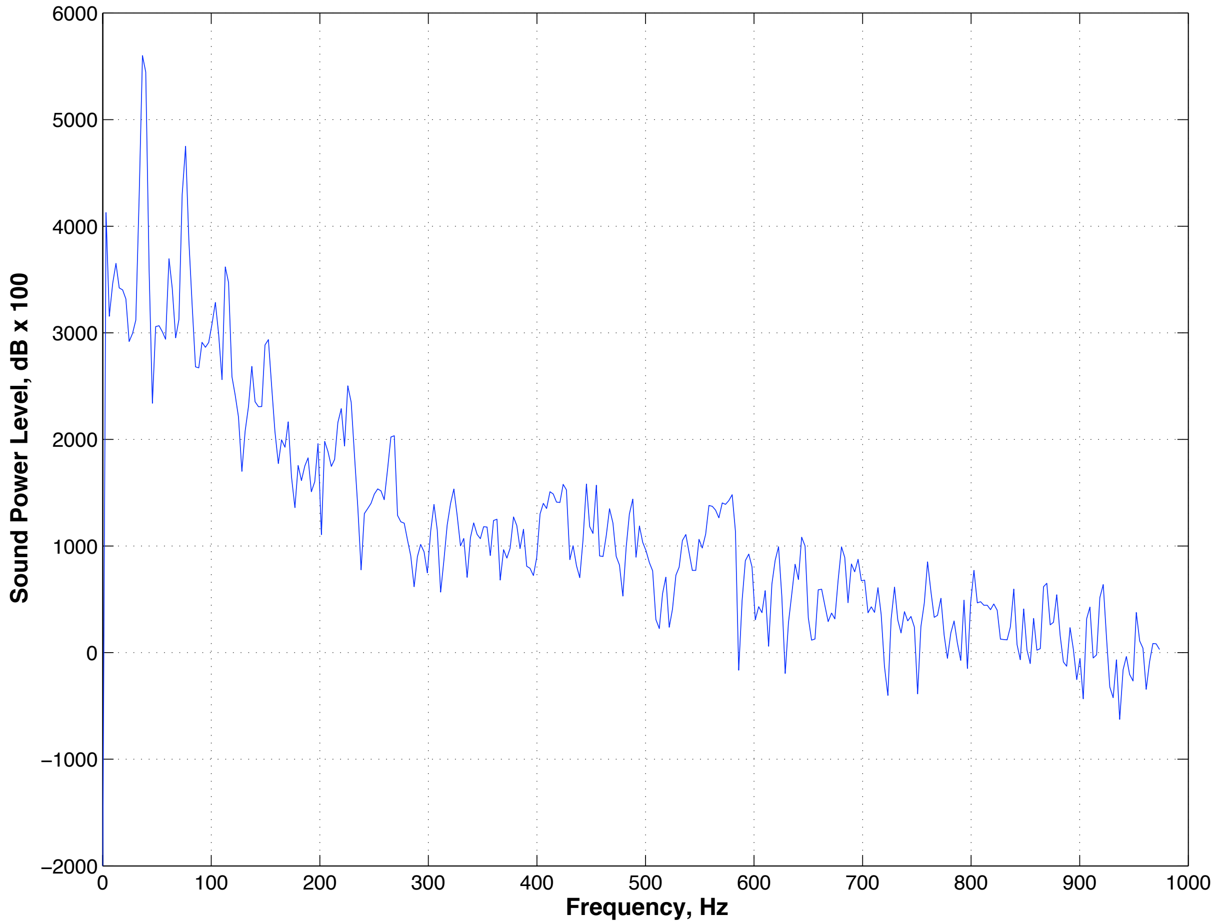

Figure 29. Narrow band plot for file 100202_08_nbd3.nc.

```
Filename: /u4/eglin07/thr/100202_08.thr
Log File:   Mic:01  Run:100
Integ:  .5000 SPLin Flat Spec:0139 Corr:    .00 Cal:    .00
Description: Third Octave Spectra:
Location: Eglin AFB
Date: iiiii

SP#    Time       F     A    10   11    12   13    14   15   16 …
 ** ************ **** **** **** **** **** **** **** ****
    AMBIENT        0    0    0    0    0    0    0    0    0 …
 1 07:15:47.537    0    0  387  367  363  374  359  414  586 …
 2 07:15:47.958    0    0  326  366  347  386  366  422  590 …
```

Figure 30. ART third octave band file format.

```
nc = netcdf('/Volumes/LaCie/Eglin III Data/MD902/semispheres/MD902202.nc', 'noclobber');
if isempty(nc), return, end

%% Global attributes:

nc.title = ncchar("MD902 Run 202 08/20/2007 Eglin AFB Acoustic Flight Test Narrowband
Band     \0");

%% Dimensions:

nc('BB') = 1;
nc('NB') = 1;
nc('PT') = 1;
nc('DOPPLER_SHIFT_REMOVED') = 1;
nc('EMPTY_WEIGHT') = 1;
nc('FUEL_WEIGHT') = 1;
nc('LOAD_WEIGHT') = 1;
nc('RADIUS') = 1;
nc('FLIGHT_PATH_ANGLE') = 1;
nc('PYLON_ANGLE') = 1;
nc('SPEED') = 1;
nc('MASTTILT') = 1;
nc('XYZ') = 3;
nc('PHI') = 19;
nc('THETA') = 37;
nc('FREQUENCY') = 31;

%% Variables and attributes:

nc{'BB'} = ncfloat; %% 1 element.
nc{'BB'}.unit = ncchar("\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'NB'} = ncfloat; %% 1 element.
nc{'NB'}.unit = ncchar("\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'PT'} = ncfloat; %% 1 element.
nc{'PT'}.unit = ncchar("\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'DOPPLER_SHIFT_REMOVED'} = ncfloat; %% 1 element.
nc{'DOPPLER_SHIFT_REMOVED'}.unit = ncchar("\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'EMPTY_WEIGHT'} = ncfloat; %% 1 element.
nc{'EMPTY_WEIGHT'}.unit = ncchar("POUNDS\0\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'FUEL_WEIGHT'} = ncfloat; %% 1 element.
nc{'FUEL_WEIGHT'}.unit = ncchar("POUNDS\0\0\0\0\0\0\0\0\0\0\0\0\0\0");
```

Figure 31. Semi-sphere one-third octave file format.

```
nc{'LOAD_WEIGHT'} = ncfloat; %% 1 element.
nc{'LOAD_WEIGHT'}.unit = ncchar("POUNDS\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'RADIUS'} = ncfloat; %% 1 element.
nc{'RADIUS'}.unit = ncchar("FEET\0S\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'FLIGHT_PATH_ANGLE'} = ncfloat; %% 1 element.
nc{'FLIGHT_PATH_ANGLE'}.unit = ncchar("DEGREE\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'PYLON_ANGLE'} = ncfloat; %% 1 element.
nc{'PYLON_ANGLE'}.unit = ncchar("DEGREE\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'SPEED'} = ncfloat; %% 1 element.
nc{'SPEED'}.unit = ncchar("KNOTS\0\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'MASTTILT'} = ncfloat; %% 1 element.
nc{'MASTTILT'}.unit = ncchar("DEGREE\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'XYZ'} = ncfloat('XYZ'); %% 3 elements.
nc{'XYZ'}.unit = ncchar("FEET\0E\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'PHI'} = ncfloat('PHI'); %% 19 elements.
nc{'PHI'}.unit = ncchar("DEGREE\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'THETA'} = ncfloat('THETA'); %% 37 elements.
nc{'THETA'}.unit = ncchar("DEGREE\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'FREQUENCY'} = ncfloat('FREQUENCY'); %% 31 elements.
nc{'FREQUENCY'}.unit = ncchar("HERTZ\0\0\0\0\0\0\0\0\0\0\0\0\0\0");

nc{'AMPLITUDE'} = ncfloat('PHI', 'THETA', 'FREQUENCY'); %% 21793 elements.
nc{'AMPLITUDE'}.unit = ncchar("DECIBEL\0\0\0\0\0\0\0\0\0\0\0\0");
```

Figure 31. Semi-sphere one-third octave file format (concluded).

Title = "Eglin AFB Noise Test Tracking Data"
Variables = Time, X, Y, Z, Vkts, Heading1, Roll, Pitch, Heading2

```
# Vehicle: MD902
# Run No.: 100203

# Parameters:
#   Time: UTC Local Time, seconds from midnight
#   X: Distance along flight track, ft (relative to center mic)
#   Y: Lateral distance, ft (relative to center mic)
#   Z: Altitude, ft (relative to center mic)
#   Vkts: Aircraft speed, knots
#   Heading1: Ground track heading reference to magnetic north,  deg
#   Roll: Roll attitude, deg (+ roll to starboard)
#   Pitch: Pitch attitude, deg (+ pitch nose up)
#   Heading2: Instrumented magnetic heading, deg
#   ROC: Rate of Climb, ft/min
```

Zone T = "100203"

26432.80	-6488.70	0.20	162.50	65.17	183.02	1.49	-0.22	180.87
26433.00	-6466.80	-0.70	162.60	65.17	183.15	1.35	-0.55	180.95

Figure 32. Aircraft data format.

Title = "NASA Tethered Weather Balloon Data"
Variables = "Altitude, ft" "Pressure, mb" "Temperature, F" "Relative Humidity, %" "Wind Speed, kts" "Wind Direction, deg mag" "Hour" "Minutes" "Seconds"

```
# Parameters:
# Altitude, ft: Balloon altitude
# Pressure, mb: Atmospheric pressure
# Temperature, F: Ambient temperature
# Relative Humidity, %
# Wind Speed, knots
# Wind Direction, degrees magnetic
# Hour Minutes Seconds: Local time of acquisition
```

2.0	758.2	73.3	85.3	0.6	315.0	7	6	38
2.0	758.2	73.0	84.8	0.6	14.0	7	6	41
2.0	758.2	73.5	84.6	0.9	11.0	7	6	44

Figure 33. NASA weather data format.

Title = "Ole Miss Tethered Weather Balloon Data"
Variables = "Altitude, ft" "Temperature, F" "Relative Humidity, %" "Wind Speed, kts" "Wind Direction, deg mag"

```
# Parameters:
# Altitude, ft: Balloon altitude
# Temperature, F: Ambient temperature
# Relative Humidity, %
# Wind Speed, knots
# Wind Direction, degrees magnetic

 -16.4   72.2   94.1    1.2   47.0
 -16.4   71.7   96.1    0.0   81.0
 -16.4   71.5   95.8    0.0   73.0
```

Figure 34. Ole Miss weather data format.

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14. ABSTRACT
A series of three flight tests have been conducted at an Eglin Air Force Base remote test range located in the Florida panhandle. The first was the "Acoustics Week" flight test conducted in September 2003. The second was the NASA Heavy Lift Rotorcraft Acoustic Flight Test conducted in October-November 2005. The most recent was the Eglin Acoustic Week III test conducted in August-September 2007. This series of tests acquired acoustic data for a number of rotary and fixed wing aircraft and are used to generate noise semi-spheres used in predicting the acoustic footprint for prescribed flight operations. This extensive database can be used to determine the impact of flight operations on communities around a terminal area as well as for prediction code validations. Another valuable use of the semi-spheres is determining the long-range propagation of noise for civilian and military purposes. This paper describes the third test in this series. Data described in this report were acquired during testing of the MD-902 and Mi-8M aircraft. In addition, data acquired during a set of atmospheric propagation tests is also described.

15. SUBJECT TERMS
Acoustics; Flight Test; Rotorcraft

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